Report made to the Hon. Thomas Corwin, Secretary of the Treasury, by Professor R. S. McCulloh, of his operations at the mint of the United States, in refining California gold by his zinc method.

McCulloh, R. S. (Richard Sears), 1818-1894.
Washington, Gideon & Co., Printers, 1852.

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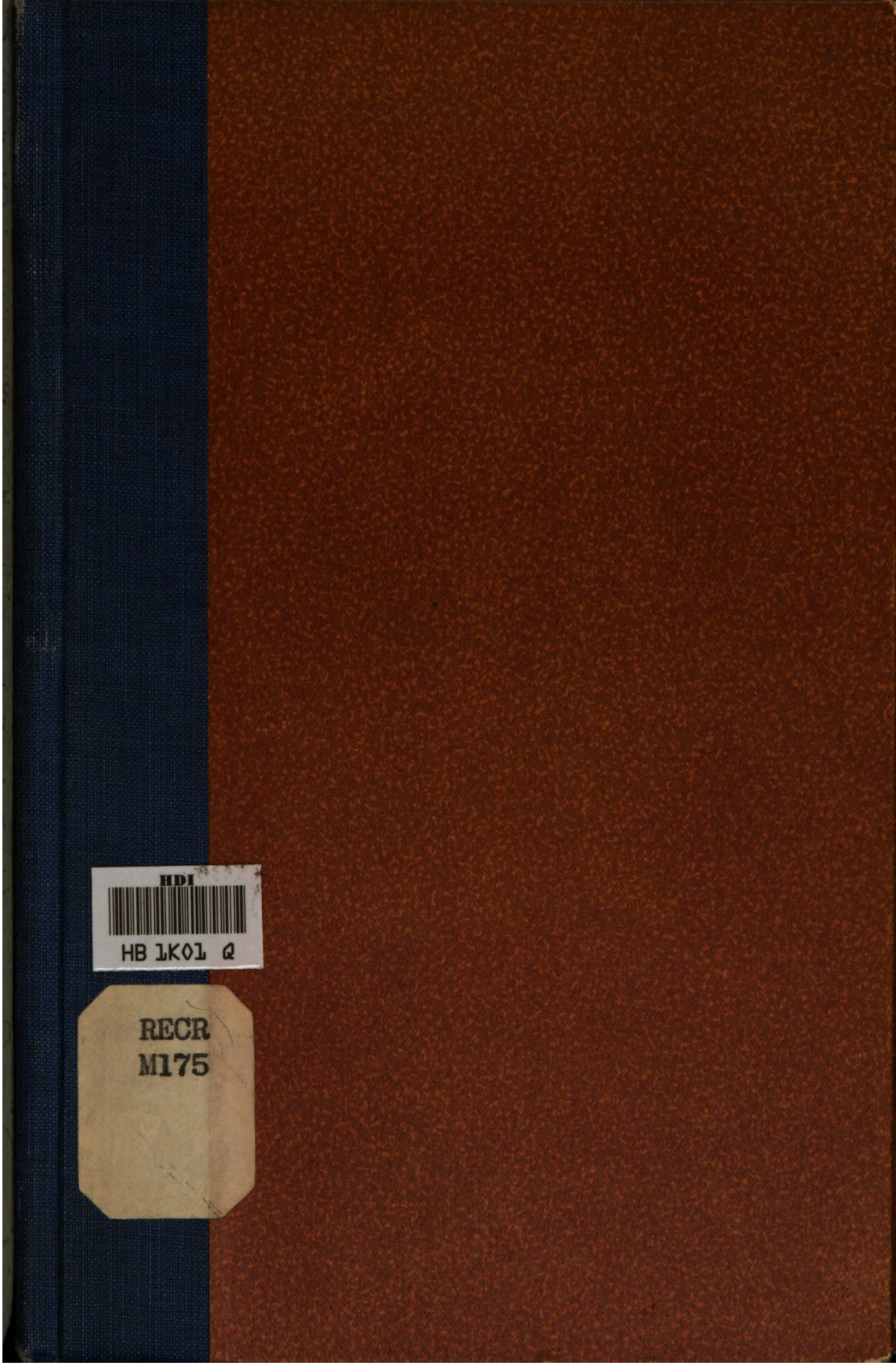
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REPORT

MADE TO THE

HON. THOMAS CORWIN,

SECRETARY OF THE TREASURY,

BY

PROFESSOR R. S. McCULLOH,

OF HIS

OPERATIONS AT THE MINT OF THE UNITED STATES,

IN

REFINING CALIFORNIA GOLD

BY HIS

ZINC METHOD.

WASHINGTON:
GIDEON & CO., PRINTERS
1852.

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TREASURY DEPARTMENT, *December 26th*, 1851.

SIR: I forward herewith the copy of a letter from Professor McCulloh on the subject of his views as to the mode of testing his new process for parting gold and silver bullion. It is the wish of the Department that the process should have a full and fair trial at the mint in Philadelphia, and you are requested and instructed to afford Mr. McCulloh the needful assistance and facilities for so doing. In order that there may be no cause for complaint on his part, of either error or mistake, the actual process will be conducted under his especial direction, and with the concurrent custody of the bullion, during the whole operations, between him and the proper officer of the mint. It is understood and agreed with Mr. McCulloh, that the United States are to be guaranteed by him from all loss or expense attending the trial beyond what attaches to the present mode, though any additional expense for erecting furnaces, and which may be subsequently useful to the United States, will be borne by the mint; and that any additional advantage or profit attending his present process will be applicable to pay any extra expense, outlay, or loss of any kind, which may attend the proceeding, for which he might otherwise be liable.

The experiment can, in any result, be carried to the extent of the separating of two or three hundred thousand dollars of bullion; and if, from that result, you find no serious loss is likely to occur, you can continue it on a larger scale, as you and Mr. McCulloh may deem necessary or advisable; or until he may be satisfied as to the extent of the operation.

You will please understand that the Department wishes the process tested in a manner and to an extent which will enable you to report fully and definitely as to the nature of it; and whether it will be advisable to introduce it permanently into practice in the future operations of the mint and branches.

Very respectfully, your obedient servant,

WILLIAM L. HODGE,
Acting Secretary of the Treasury.

Dr. G. N. ECKERT,
Director of the mint, Philadelphia, Penn.

PRINCETON, *November* 13, 1851.

SIR: Your favor of the 15th ultimo, and the enclosed copy of a report from the director of the mint of the 14th ultimo, were duly received.

For the present, I forbear from remarks upon said report, except in relation to the practical question of a trial of my process for refining gold, to be made at the mint, and in my presence.

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Such a trial having been recommended by the director of the mint, and he having suggested that it might be equitable "that any loss of gold, if over and above the ordinary wastage, be borne by Mr. McCulloh," you have been pleased to inform me, that the Department will authorize a renewed trial, and that "it coincides in the opinion of the director, that any loss of gold which may accrue in making the experiments should be borne" by myself.

As it was, I presume, the intention of your instructions to the director of the mint, dated January 11, 1851, to accord what I had requested in my letter to you of December 23, 1850, that my aforesaid process should be tried "under my direction," and as it is now, I suppose, the object of the proposition concerning excessive loss, if any should take place, which I believe impracticable, that the United States may not incur risk thereof by experiments to be tried by me, I respectfully submit that I will assume, and relieve the Government from, the risk and expense, if made under and in compliance with the following conditions:

1. That an account shall be opened between the contingent fund of the mint and myself, by the treasurer of the mint, in which I shall be charged with the cost of the labor and materials employed by me, and the loss or waste of gold and silver which may occur in the trial of said process; and shall be credited with the amount charged according to the present rates, and paid by the depositors of the bullion operated upon by me, for labor and materials to be employed in refining or reducing said bullion to the same composition, fineness, or degree of purity, and shall also be credited with an allowance equal to the ordinary waste or loss of gold and silver incident to the operations requisite for said purpose by the method now employed in the mint; said ordinary wastage, or the rate thereof, to be first determined and agreed upon by the director of the mint and myself. And any loss or profit which may be exhibited by said account shall accrue, in the settlement thereof, to myself and not to the United States:

2. That the operations of said trial shall be conducted under my exclusive direction and control; and such gentlemen as I may invite, shall be permitted to be present, and to verify any of the acts or results:

3. That the bullion operated upon shall be in the joint custody of the treasurer of the mint and myself, or, in the absence of either, then of such person or persons as he may designate and authorize to personate him; and said bullion shall be kept entirely apart from the bullion in charge of the melter and refiner, and in such manner as may be agreed upon by said treasurer and myself:

4. That, if after having refined an amount not exceeding $250,000, it shall not appear that the waste and expense are necessarily such as will devolve loss on the Government by continuing the trial, then said trial shall proceed under my direction and the concurrent custody aforesaid, to determine and establish whether the process can be applied in refining the usual large amounts of gold daily operated upon in the mint, with greater dispatch and economy than are attained by the process now employed:

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5. That, before operating upon a large quantity, I shall be allowed to cause several small operations, of one or two thousand dollars each, to be performed, for the practical instruction of the workmen, and the convenient adaptation of the method to the apparatus and manipulations to be used by them; and shall be permitted to take small samples for assay in exchange for gold of equal quantity and value:

6. That every proper facility shall be extended to me, and such apparatus as I may require, if not available in the mint, shall be ordered and constructed, or modified, under my direction, the cost to be borne by me, if the said apparatus will not be useful in the mint, after I shall have concluded my operations.

Very respectfully, your obedient servant,

RICH'D S. McCULLOH.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

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REPORT.

To the honorable THOMAS CORWIN,
Secretary of the Treasury.

SIR: After having received authority to try, in the mint at Philadelphia, my method of refining gold by the use of zinc, I went there without delay, and delivered to Dr. G. N. Eckert, director, the letter of instructions from the Department of December 26th, 1851, and the copy contained therein of my communication to you of the 13th November, 1851. A slight difficulty at first arose, owing to the treasurer having objected to permit gold bullion in his charge to go into the refining rooms to be there operated upon by workmen under my direction; but, after correspondence by the director with the Department, arrangements were made, by which all that I had asked and the Department had authorized was conceded to me substantially, though varied in form.

2. The general conclusions, or facts, established by my consequent proceedings, and which I have now the honor to submit, for your information, are as follows:

First. That the previous experiments upon refining with zinc, conducted by officers of the mint, in which, besides other errors, *more than seventeen ounces of gold were left in the furnace*, did not prove that said gold had volatilized; or evince care, skill, or accuracy, accidents not having occurred to mar their designs:

Secondly. That there is no reason to believe that volatilization occurs, when an alloy of zinc and gold is properly made, at a temperature below that of redness, as was done in my large operations, by dissolving gold bars in melted zinc:

Thirdly. That, by means of suitable apparatus, the granulating of gold, with zinc or silver, to prepare it for refining, can be more perfectly, economically, and expeditiously done by machinery than by hand, and much waste avoided:

Fourthly. That, by my method of refining, about $250,000 were refined under my direction without difficulty, and the refined gold was of the very best quality for coining:

Fifthly. That when, after having made three preliminary workings, I was ready to demonstrate fully the great advantages of my process in economy of time, labor, and materials, by making an operation upon $750,000, or about $1\frac{1}{4}$ tons of gold, the opportunity to do so was denied to me, for the reasons alleged by the director: that it could not be permitted, as he did not feel confident that gold so refined would be fit for coining, and that the regular business of the mint might be interrupted by such a result:

Sixthly. That my method of refining is much more economical, in materials and labor, than the method now used in the mint, and that

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my workings were actually attended with a saving, in materials and labor, to the amount of $110 41, which might have been much increased:

Seventhly. That my zinc method of refining is not subject to more wastage than the silver process employed; and that my only working, in which accident did not occur, compares favorably with the results of one, made for a like purpose by said silver process, and reported by the late director of the mint, Dr. Patterson, in his letter of May 9th, 1851, to the Department:

Eighthly. That in two of the three workings, made under my direction, accidental spilling of melted metal occurred—to which, however, my method is not more liable than other methods are—and that these accidents caused an apparent excess of wastage, notwithstanding which the aggregate returns were deficient to an extent only of about one half of the least wastage shown in the experiments made by the officers of the mint, which were not attended with evident accidents; and that any seeming loss, which these accidents may have occasioned, has been fully compensated to the mint by an amount of gold, which I have caused to be delivered to the director for that purpose, although I might equitably have been considered free from any such pecuniary liability:

Ninthly. That my method of refining would save all the silver, wasted in the present process, out of the large quantities used for quartation; and that this saving, in my aforesaid workings, probably amounted to more than 21 ounces:

Tenthly. That the question of the comparative wastage of gold, in the two methods of refining under consideration, is one within the limits of the probable error of the most accurate assays; and in relation to which, these do, therefore, become to some extent uncertain, and in an equal degree inadmissible:

Eleventhly. And, finally, that by my method of refining, besides saving the interest now incurred by the nation, there might have been saved $106,579.87 out of $212,285.38, charged to the depositors of gold bullion, for silver alloy, and for materials and labor, required to separate the silver from their gold, during the period beginning November 14, 1850, and ending December 31, 1851; and of which $212,285.38, all that portion charged as silver alloy, and amounting to $88,337.75 was lost, not only to the depositors, but also to the industry and wealth of our country:

3. But that all of these facts may be fully shown, I have seen fit to present the following details; and that the statements made therein may be confirmed by the testimony of disinterested and intelligent persons, who witnessed what I did, I have addressed interrogatories to and received replies from workmen of the mint and others, who assisted me, for copies of which, see Nos. 1 to 19 of the Appendix. And I may here add, that no one of the officers or clerks of the mint, who were all commonly occupied in their respective avocations, and only occasionally came into the workshops, either followed my proceedings

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or can speak of knowledge fully, connectedly, and accurately concerning them.

The superintendence of the weighings of the gold was devolved by the director upon Mr. Benson, his clerk and nephew. But to the workmen alone, and particularly to Messrs. Monell and Porter, foremen of the melting and refining department, was entrusted the responsibility of observing and aiding in the operations performed, the taking of accounts of materials and labor used, and the concurrent custody of the metal refined under my directions.

Martin Summers, formerly, and for many years, gold melter in the mint, and Townsend Yearsley, brother of Pascal Yearsley, bricklayer at the mint, were assistants employed by me, with the approbation of the director. Woods Baker, esq., of the U. S. Coast Survey, also aided me, in pursuance of instructions of the Department.

4. After I had examined the melting and refining department, in company, first with the director, and then with the melter and refiner, Prof. Booth, on the day of my arrival at the mint, it was agreed between said director and myself, with the consent of the melter and refiner, that Pascal Yearsley, the bricklayer of the mint, should proceed, under my directions, to tear down the cupelling or reverboratory furnace, which had been constructed in the basement or cellar, in January, 1851, and to rebuild the same in such manner, as requested by Prof. Booth, that it would be adapted to the convenient refining of silver, after I should have employed it for refining gold—the plan of the new furnace to be first submitted by me to Prof. Booth, and to be approved by him. The three silver melting furnaces were also placed at my disposal; two of which required to be rebuilt, and the third to be removed to make room for a new furnace, which I intended to use for alloying and granulating the zinc and gold. I was occupied during the whole of January, and until the 5th of February last, in the aforesaid task of constructing furnaces, and superintending the machine work needed for my granulating furnace, the execution of which required much time, and retarded the brick work.

5. When the aforesaid cupelling furnace was torn down, Mr. Yearsley, according to my orders, caused all the dirt, &c., contained therein, to be carefully removed and delivered to Thomas Llewellen and James Kane, workmen of the melting department, who extracted from said dirt, by grinding, sifting, and washing it, seventeen ounces of gold in grains, which were melted by Archibald Porter, foreman of the melting operations.

As said furnace had been constructed and used by the officers of the mint for their experiments upon my method, and had never been employed for other workings, the finding of seventeen ounces of gold therein proves that those experiments were incorrect, and that this gold, left by those officers in said furnace, had not escaped up the chimney, in conformity with their hypothesis of wasteful volatilization.

As grinding, sifting, and washing neither do nor can extract from

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auriferous dirt the whole of the gold contained therein, but do always leave a considerable portion, which may afterwards be obtained by amalgamation, or by fluxing, it follows, that there must have been gold in said dirt which the aforesaid workmen did not and could not extract. To ascertain the quantity so contained, I caused said dirt to be carefully gathered and set apart, and repeatedly requested the director of the mint to have assays thereof made, which he consented to do, but if they have been made, the results have not been communicated to me, although I have asked for them.

6. In the month of January, 1852, before my granulating furnace was constructed, but after two of the above mentioned silver melting furnaces had been rebuilt, I tried with them, as the only means I possessed, a preliminary experiment of refining 303.24 gross ounces of gold with zinc. But as the director desired to use these two furnaces for an operation, to determine the actual wastage attendant upon the method of refining gold employed in the mint; it became necessary, in making my alloy of gold and zinc, and in granulating the same, that I should use such means only as would preclude the possibility of any of the gold, of my experiment, being spilled into either of said furnaces. I, therefore, melted the zinc in one furnace, and the gold in the other, and, when both metals were perfectly liquid, I caused the crucibles containing them to be lifted bodily from the furnaces, and the gold to be poured slowly, at first, by one workman, into the zinc, while another workman stirred the mixing metals, to form a perfect alloy. The workman who was pouring the gold called my attention, after some time, to the fact, that the slowness of the operation was causing the gold in his crucible to become chilled, and partially to solidify. I then permitted him to pour the remainder rapidly. A piece of soap, which I had thrown into the alloy to protect it from oxidation by the air, had nearly or quite burnt off, when the rest of the liquid gold being poured quickly into the zinc, the too rapid increase of temperature, uniting with the effect of exposure to the air, caused combustion of the zinc to take place, and with such intensity at first, that some of the hot metal was projected from the crucible, and scattered in drops or grains upon the floor and various surrounding objects, from which they were gathered as well as we could. One of these grains coming in contact with part of the adjacent wood work of the mint, rendered very combustible by saturation with nitre from the refining operations, it took fire, which having been extinguished, we forthwith proceeded to granulate the alloy; and this metal being passed through the various subsequent stages of my process, yielded refined gold of the very best quality, which was, also, perfectly tough when melted. The apparent loss upon this experiment was about 0.44 oz., being approximately $1\frac{1}{2}$ thousandths. It may be here remarked that $2\frac{8}{10}$ thousandths was the least wastage reported as having occurred in any of the experiments made previously by officers of the mint upon refining with zinc, and in which accidents are believed not to have occurred. And in this experiment of mine, not only combustion of

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zinc occurred, but some of the alloy was projected from the crucible, and part thereof having fallen into a pan standing near at hand, containing metal that belonged to the regular work of the mint, was not recovered, and could not be reclaimed by me. I did not regret this accident, for it presented a case in which the hypothesis of volatilization called for a very great wastage, and I so stated to the director of the mint at the time, but no such marked effect ensued. I should add that this accident, which occurred from the use of provisional arrangements, could never happen in the use of my granulating, or other appropriate, furnaces.

7. On the 4th of February, my granulating furnace being finished, and sufficiently dry, fire was kindled in it, and we proceeded to try it with zinc alone. The moisture in the brick-work rendered the heating of the furnace rather a slow operation; but when the metal (343 lbs. of zinc) was melted, the valve was opened, and it flowed in eight streams down into a large copper kettle containing water, and placed in the cellar below. Every thing worked perfectly; the granulation was superior, and the operation was spoken of in terms of high admiration by all who witnessed it. I should here state that this arrangement for granulating is new, and had never before been reduced to practice. It is part of the apparatus adapted to the working of my process for refining with zinc, to which I referred in my memorial to Congress of July 5th, 1850, and in my letter to Professor Booth of July 16th, 1850; also in my letter to the Secretary of the Treasury of February 28th, 1851; and its introduction would be a great improvement in the refining apparatus of the mint, even if zinc be not used instead of silver. With the results obtained by using this furnace, the director of the mint was so much pleased that he freely expressed his admiration of them; and subsequently, without adverting sufficiently to the fact that the aforesaid arrangement was exclusively my own, he was proceeding to apply it in the work of the mint; but upon my remonstrance, in writing, copy of which, and of his reply, is annexed, (see Appendix, Nos. 20 and 21,) he refrained from so doing.

8. On the 5th of February, I commenced my larger refining operations by granulating 1952.72 ounces of gold, with about 5,000 ounces of zinc. When the zinc was melted, the gold bars, heated to incipient redness, to prevent their chilling the zinc, were put, one after another, into the zinc, which readily dissolved them without elevation of the temperature to that of redness. The alloying was easily and perfectly done. And, as the director of the mint stood by my side looking at the operation, I caused the melted alloy to be skimmed, so as to present a clean, bright, and exposed surface to the oxidizing action of the air, and then requested him to watch it closely, and observe whether he could perceive the slightest indication of volatilization or fumes of zinc; he admitted that he could not see, and did not believe there was any.

In granulating, a difficulty was, however, met with; the pipe passing down into the water, contained in a large copper kettle placed on

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a carriage in the cellar below, notwithstanding my orders that it should not be raised, had been elevated by some curious person; consequently, a draught of cold air came up through it, which chilled the metal in the bottom of the crucible; so that, when the valve was opened, it was found to be obstructed, and only four of the eight openings allowed streams to flow from them; three of these soon stopped, and the fourth or remaining stream became much diminished; it, however, continued to flow until all the melted metal was discharged from the crucible. The granulation was very beautiful, but the valve with eight openings was so clogged with solidified metal that it was ruined. Orders were at once given by me for a new valve with only four openings, and for an iron bed plate, to be placed under the crucible in the furnace, so contrived as to render a similar accident impracticable, even if the pipe should be disturbed. The size of the aforesaid copper kettle was not sufficient for the quantity of metal; it therefore became necessary to slip another similar vessel under the flowing metal; to do this, a small pan or kettle was momentarily used to receive the flowing metal, while one of the large kettles was removed and the other substituted for it, which was readily done.

9. On the morning of February 6th, several ounces of alloyed gold and zinc in grains, belonging to the working of the preceding day, were gathered in a scoop, which, by my order, was placed by a workman on the top of one of the melting furnaces, behind a number of large crucibles. I was called, for a few moments, from the room to give directions concerning another matter, and upon returning observed that said scoop and grains were missing. Inquiry was made by me of the aforesaid workman and other persons, but no one knew what had been done with the scoop and grains. Curiosity had drawn a number of the workmen of the mint about my furnace, and others came there prompted by a desire to render service to me. I could not believe that any of them would intentionally injure my work, and therefore concluded that some one had taken the scoop to use it as a tool, and in so doing had thoughtlessly rendered it impossible to know what became of the grains, which had been placed temporarily where I supposed they would be free from displacement. I promptly mentioned this occurrence to the director of the mint, though not in a spirit of complaint, and requested him to give orders that no one, unless employed in my work, should, in any respect, interfere therewith, or come so near to my operations as to impede them.

10. About noon, on the 6th of February, the new valve and bed-plate being finished, fire was kindled again in the furnace, and another operation upon 1963.58 ounces of gold and about 5,000 ounces of zinc was commenced; about dusk, the metal was all melted and ready for granulating; the valve was opened, and four streams of melted metal flowed from it down into the water contained in one of the large copper kettles, placed in the cellar as aforesaid. But when this kettle was removed, that another might be substituted for it, the sliding pipe accidentally slipped from its place, the small pan

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was thereby knocked from the hands of the workman who was holding it, and, for a few moments, the four streams of melted metal poured down upon the cellar floor, splashing upon the persons and objects around, and scattering in particles to some distance over the floor. This accident was the only serious one which occurred during my whole work; for, though the metal was gathered up as carefully as could be done, yet apparent loss could not be avoided, as it was dispersed widely and finely, and, as many persons were standing near at the time, all of whom had their clothes and shoes more or less sprinkled or studded with metal, and some of whom were there only as spectators, attracted by the curiosity which the novelty of my operations awakened, and which the instructions, issued by the director, in compliance with my aforesaid request, had not restrained. This curiosity I mention, not in censure, for it was natural and innocent, as those who were present certainly did not know, that its indulgence was contrary to my wishes, expressed reluctantly, yet unavoidably, as one effect of it was to embarrass the operations of the workmen who had been detailed to aid me.

On Saturday, the 7th of February, we were chiefly engaged in gathering the metal scattered by the accident of Friday. On Monday, the 9th, and Tuesday, the 10th, alterations required by the new bed-plate were attended to. Simplified valves, designed for a single stream of metal, were made; and the metal, granulated on the 5th and 6th, which had been put into acid without delay, received attention. Hogsheads were procured and prepared for receiving the metal in granulating, as substitutes for the copper kettles; a single hogshead being large enough to hold the entire charge of the crucible without shifting, so as to preclude accident.

11. On the 11th, another granulation of 1,995.48 ounces of gold, with about 5,000 ounces of zinc, was made without the least difficulty. And immediately afterwards, two successive zinc granulations, each of 5,000 ounces troy, or 343 lbs. avoirdupois, were made, also without difficulty; the object of which was to clean or *wash* out the crucible with melted zinc. But this operation not having perfectly attained the desired end, the crucible, which was of wrought iron, was taken on the following day, the 12th, to the large machine shop of Isaac P. Morris & Co., and there bored out, under my superintendence, in the manner that cylinders are bored for steam engines. This operation consumed the entire day.

12. It would overload this report with unnecessary details were I to relate chronologically the operations of each successive day; nor would it be practicable for me, by so doing, to render evident to the department all the features of my work. My operations involved two leading questions, to wit: *first*, the merits of my method of refining by the use of zinc; and, *secondly*, the merits of my granulating apparatus; modifications of the latter were tried with the view to test, practically, their respective advantages and disadvantages; and the valves, especially, were varied in every possible mode—they were

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placed internally and externally, horizontally and vertically—were made to work by levers and by screws, and to give from one to eight streams.

13. As all responsibility devolved upon myself, and as others would have been held to be censurable for anything they might do in error, however well designed, the workmen had instructions from me to do nothing, except by my express orders and under my immediate direction; therefore, whenever I was attending to the granulating furnace, or its work, the operations with acids were held in suspense, and, conversely, the granulating was checked when the refining was in progress. Besides, when I was absent from the mint, attending to such matters as the aforesaid boring of the crucible, or to analyses of the materials employed by me, which I made in the laboratory of my friend, Dr. Charles Wetherill, who kindly placed it at my service, all my work at the mint was arrested.

I have set forth these facts, because it should be understood, that my preliminary trials were made without reference to the questions of comparative time or economy of labor and materials.

14. The 5,911.78 ounces of gold, or about 400 pounds avoirdupois, which I have granulated in three separate parcels, were refined with acid, as one lot, and designated by me as lot No. 2; they were then toughened in the same black-lead crucible, which was twice filled; each filling having been dipped out and cast into bars; some metal, still remaining in the crucible, was cast into a residual bar. These bars were afterwards numbered promiscuously from 1 to 18. The bars of the first casting, which were, therefore, all of uniform quality or fineness of metal, were Nos. 7, 11, 12, 13, 14, 15, and 17. Those of the second casting, also of homogeneous quality, were Nos. 1, 2, 3, 4, 5, 8, 10, 16, and 18; the residual bar was marked No. 6; and to avoid mistake from inverted reading, there was not a No. 9. All of these bars were of perfectly soft and tough metal.

15. I have particularly mentioned that they were melted in a black-lead crucible, because it had been imagined that gold refined with zinc cannot readily be rendered tough, free from brittleness, if melted in black lead crucibles; which are the kind usually employed for the precious metals—an error that is embodied in the official report of J. C. Booth, melter and refiner of the mint, February 6, 1851, to Dr. R. M. Patterson, director, recommending the adoption of my method of refining—copy of which is annexed, see No. 22, of the appendix.

16. My reason for numbering each bar separately was, that I had understood special assays had been made of every bar delivered to me, and therefore supposed that the same rule would be followed with reference to those returned by me; and I caused them to be numbered in irregular order, the more effectually to verify or check the results of the assays. The assayer complained of the amount of work it would require to assay every bar; and therefore, in my subsequent meltings, through courtesy to him, I did not follow the same course; but numbered the bars of each casting with the same number, though, in so doing, the advantage of a verification of assays was yielded by me.

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17. On Monday, February 16th, I granulated 7,874.05 ounces of gold, the value of which was nearly $150,000. This was the remainder of the $250,000 which I was authorized by the Department *to refine under any circumstances*. During the rest of the week, this gold was put forward in the acid, though not with the despatch which would have attended uninterrupted work, nor with either the purpose or effort to economize in time, materials, or labor. My attention was chiefly given to the chemical points involved in every stage of the operation, to the avoidance of wastage, and to the instruction of the workmen in the routine required; while the work was allowed to proceed deliberately, but carefully. On Saturday, the 21st, the refining of this lot of 7,874.05 ounces of gold was complete, and it was ready to be washed, dried, and melted.

18. I then informed the director that, on Monday and Tuesday, I would, with his consent, granulate $750,000 in gold, and refine the same during that week, as this sum would complete $1,000,000, and the workmen had become sufficiently familiar with the operations to be performed, and as the apparatus was in condition to work, without any trouble, to my entire satisfaction; and that I proposed to demonstrate, by the rapid refining of these $750,000, the advantages of my method, in economy of time, labor, and materials, which I had not sought to do in my previous work. I also remarked that the profits would reimburse me for my outlay of several hundred dollars for apparatus, &c.

19. To my surprise and disappointment the director objected, and said that he did not then feel authorized to permit my refining to proceed upon further quantities, as it had become necessary for him to interrupt my work for the reasons alleged: that gold bullion had accumulated in the mint to a very large amount, and the balance of coin in the hands of the Treasurer applicable to the payment of deposites had consequently been so diminished that, to enable them to provide more to pay for gold expected daily to arrive from California, it was requisite that my operations in refining gold with zinc should be suspended, and that the regular work of the mint should proceed on Monday, with the aid of the separating apparatus that I was using; and, moreover, because he would be unwilling that one million of dollars should be made into bars like those refined by me, before it had been shown that they would be adapted to the operations of the coining department.

20. The director at the same time expressed his regret that the exigency of the public service should compel him thus to interrupt my proceedings, and to take from me the separating apparatus I was using; and a desire that, at some early and mutually convenient period, I would come to the mint and refine gold bullion to the extent of a million of dollars, to teach the workmen thoroughly how to refine it by my method. To this I replied, that I would of course do so, whenever the Government should provisionally agree to acquire the right to use said method.

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21. I then submitted, however, for the consideration of the director, the propositions—that I could and would refine a million of dollars more promptly by my method than could be done by using the silver process; and that I would ask the Treasury Department to transfer, temporarily, to the mint a sum of the public moneys sufficient to meet any immediate transient necessity, and so to enable me to complete my work without interruption. To these propositions he might have consented, if he had not believed that such transfer could not be obtained, and if previous trials had shown that the gold which I had already refined was well adapted to the operations of the coining department; but as he held both to be uncertain, and upon these grounds decided that it would be necessary that I should yield up the separating apparatus, I did this unhesitatingly, in deference to his expressed opinion that the public business required it.

22. The large lot of gold I had just refined was melted in black lead pots; it was designated as lot No. 3, and was of good quality; though its fineness, when assayed, did not exceed 983.3 thousandths, as in the granulation the proportion of zinc had been reduced to that of 2 to 1, nearly.

23. The iron crucible was again bored out, and I proceeded to extract any gold contained in these borings; after which, grains were gathered from crucibles, furnace dirt, fluxes, &c., &c.; and these were also smelted by Martin Summers, formerly the gold melter of the mint. The gold so obtained being impure, it was refined by the use of oxidizing agents, and upon bone-ash tests; all the dirt, of various kinds, was amalgamated; the amalgam itself was distilled, melted, and refined. The granulating furnace was torn down, the apparatus thereof was taken away, and the silver melting furnace was rebuilt, so as to restore the premises to the condition in which I had found them. Finally, samples of the sweep were fluxed by Martin Summers and by Charles Hare, for the assay office.

24. And as the question whether the gold refined by me was adapted for the coining operations had been raised, I proceeded to settle it by an actual trial of part of each lot; which, having been alloyed by Martin Summers and cast into ingots, the trial of these was conducted by myself, concurrently with the foreman of the coining department, George Eckfeldt, who was authorized to take charge of it by the director of the mint. The gold was found to be of superior quality for coining; double eagles were made of it, to test the perfection of impressions stamped upon it; and gold dollars, to ascertain how well it would work in rolling. One of the strips for gold dollars, at my request, was rolled again and again, the rolls being screwed closer together each time, and until the men informed me that they could not screw them any tighter, nor make the gold strip any thinner. This very severe test did not cause the slightest injury, or reveal any imperfection in the gold; one more severe could not probably have been contrived.

25. Had I been permitted to refine the $750,000 as I had expected, I should have used the large reverboratory or cupelling furnace which

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I had constructed in the basement for melting the gold when refined; but the stopping of my work prevented me from making the use of it I had intended. For the same reason, large quantities of acid, which I had received and designed to use, and which had been charged to the account of my operations, were, in such part as was suitable for the usual work of the mint, returned and deducted, and in such other part as was too much diluted, poured away into the precipitating vats.

26. It remains only that I should present the facts relative to the materials and labor employed by me, the apparent wastage which occurred in my experiments, and the matters of account connected therewith.

There were in the *first* lot 346.12 gross ounces of gold bullion, of which 42.88 ounces were returned without being refined, as gold which had solidified in the crucible, leaving a balance of 303.24 ounces to be refined; in the *second* lot, 5,911.78 ounces were refined; and in the *third* lot, there were 7,874.05 ounces, making the aggregate gross weight of 14,089.07 ounces of bullion—upon which the mint charges for separation were, at the rate of five cents per ounce, $704 45.

There were used by me in refining or separating these 14,089 ounces of bullion:

2260 lbs. of zinc, *a* 4c. - - - - -	90 40
6245 lbs. of sulphuric acid, *a* 2c. - - - - -	124 90
1873 lbs. of nitric acid, *a* 7⅛c. - - - - -	133 45
	$348 75

The quantity of nitric acid was largely in excess, and when my operations were interrupted, much thereof had to be poured away as I have already mentioned.

It was not possible to know with accuracy the amount of labor actually employed, for men were often in attendance, though not at work. Mr. Monell estimated their time at six days, of six men, and so reported to the director; but at my request, prompted by my desire to defray all expenses, he added to this estimate one third, and stated the account of wages for six men during eight days, at $1 80—making $86 40; which the director approved.

The fuel, crucibles, borax, &c., of the refining operations proper, probably did not cost more than ten or twenty dollars. It would be, perhaps, a close approximation to estimate the actual cost of the refining of 14,000 ounces of gold bullion in my work to have been about $420, or three cents per ounce; which rate, however, would be much reduced by economizing the acid, zinc, labor, &c., and by working on large quantities in succession, through a long term.

But by referring to the accompanying accounts of materials and labor, based upon the reports of Messrs. Monell and Porter, and furnished to me by the director of the mint—for copies of which see Nos. 23 and 24 of the Appendix—it will appear that my operations are

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charged with $395 71 for acids, labor, &c., and $198 33 for zinc, fuel, crucibles, fluxes, &c.—making an aggregate charge of $594 04; which being deducted from $704 45, the sum paid to the mint by the depositors for refining said bullion, leaves a balance in favor of my operations of $110 41 for economy in materials, &c.

27. In explanation of the above excessive expense of materials, &c., $594 04, I submit, that being deprived of the separating apparatus, with which I designed and expected to have refined all the gold in my hands, I was compelled subsequently to prosecute my work by the laborious and imperfect mode of refining by fire, which increased both the expense and the wastage of my operations.

28. In relation to the apparent wastage of my work, according to my computations—see Nos. 25, 26, and 27 of the Appendix—there was:

	Gold received. *Standard ounces.*	Gold returned. *Standard ounces.*	Appar't wastage. *Ounces.*
In lot No. 1 -	340.543	340.102	0.441
In lot No. 2 -	5,822.609	5,807.448	15.161
In lot No. 3 -	7,751.820	7,745.816	6.004
	13,914.972	13,893,366	21.606

The ratio of 21.606 to 13,914.972 being 0.0015, nearly, the rate of said apparent wastage was about one ounce and a half per thousand—a rate slightly exceeding the half of 0.0028, the most favorable result obtained by Mr. Booth, as shown by an experiment not attended with accident, and reported by the late director, in his letter of March 27, 1851, to W. L. Hodge, acting Secretary of the Treasury.

29. Of the gold returned by me, as belonging to lot No. 1, there were in grains 3.53 gross ounces, which were delivered to the director, with the request that he would give orders to Mr. Porter to melt them for assay. In melting these grains, the crucible broke, and they went into the fire. In my computation they are assumed to have been of standard fineness, or 900 thousandths, and it is improbable that they were of a quality inferior to this estimate, as they were chiefly grains from melting fine gold.

30. The returns of lot No. 2, exhibiting the deficit of 15.161 out of 5,822.609 standard ounces, show that the accidents which happened to this lot, to wit, the metal having been spilled in the cellar, and the scoop of grains heedlessly displaced, probably caused a considerable increase of apparent wastage.

31. The *third* lot was the only one which was free from accidents, and it alone, therefore, furnishes data for an opinion concerning the question of the probable wastage of the zinc method of refining. The foregoing results show that of 7,751.82 ounces of standard gold 6.004 ounces were apparently lost. The ratio of this wastage is 0.00077, or nearly three-fourths of one-thousandth. Had I not been deprived of the separating apparatus, and thereby consequently compelled to refine

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gold by fire, which I would otherwise have refined with acids, the amount of the wastage, upon this *third* lot, would certainly have appeared less; making proper allowance, therefore, for this circumstance, and for effects of variation in the relative quantities operated upon, we may come to a probable and satisfactory conclusion upon this subject.

32. In pursuance of the original recommendation of the director of the mint, adopted by the Department, and assented to by me, an account was to be stated in which the difference between the actual wastage in my operations, and the ordinary wastage that would attend the refining of a like quantity of gold by the method in use at the mint, was to be charged.

And in my prefixed letter to the Department, of November 13, 1851, it was stipulated that the rate of said ordinary wastage should be preliminarily determined, by the director of the mint and myself. Soon after going to the mint, I brought this matter to the attention of the director, but as there are no accounts kept in the mint which would show what is the actual wastage of the refining operations there conducted, it was desired and proposed by the director that he should cause an experiment to be carefully performed, by the workmen of the melting department, under the direction or superintendence of Professor Booth, with the view of determining said wastage. To this proposition I freely consented.

33. That experiment was, therefore, tried with the following result:

	Ounces.		Fineness.	
Deposit No. 656. Gross wt.	1,462.39	a	887	1,441.265
657. "	1,399.65	a	880	1,368.547
655. "	794.50	a	880	776.847
				3,586.659
Wt. of refined bars No. 13.	1,557.09	a	893.8	1,546.363
" " " 14.	2,037.36	a	898.5	2,033.964
Wt. of lump from grains from granulations of gold and silver	21.44	a	225	5.360
Bal. of grs.	3.17	a	625	2.201
				3,587.888
Gain - - -				1.229

The seeming gain of 1.229 ounces, exhibited by this operation of Professor Booth, being, like that exhibited by one of his experiments previously made at the request of Director Patterson, an impossibility, further experiments were not made. The apparent gain could not be accounted for by supposing gold to have been left in the furnace, for it was one of those which had just been rebuilt, and could not have contained gold.

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34. But the director thought the result might be explained by the practice of the assay department, of deducting from the actual assay, and not reporting to the credit of the depositors, the fractions of a thousandth less than one-half. This suggestion, however, would scarcely be admissible, unless such fractional deductions did, in the particular instance, exceed half a thousandth of the whole; for they should be adequate not only to annul the apparent gain, but to compensate such actual wastage as must have occurred.

35. As the experimental method of ascertaining the rate of the ordinary wastage of refining had resulted, in the hands of the melter and refiner of the mint, in a failure; and as the acounts of that institution are not kept in such a manner as to exhibit said wastage, simple data were wanting for the preliminary and conventional determination thereof, by the director of the mint and myself, according to the stipulation made in my letter of November 13, 1851, to the Department. Hence such determination was not made by us.

36. To permit me to investigate the subject of wastage more thoroughly than the facts previously known to me, and derived from my own experience, would have enabled me to do, I requested and obtained, from the director, some facts relative to the wastage of Prof. Booth, but other information, sought by me for the same purpose, has not been obtained; if, therefore, in the discussion, which I shall now present, there be any want of accuracy or completeness, I shall welcome the further investigation of the subject.

37. In the first place, I would refer to an experiment reported by the late director of the mint, in his letter to the Department, May 9th, 1851, as having, in his belief, shown that of 888.176 ounces of pure gold 887.643 ounces were returned, and 0.533 was apparently lost in the operation of separating by the usual method of granulating with silver. This is at least an admission, on the part of said director, that a seeming wastage of "$\frac{6}{10}$ths of an ounce per thousand" was by him considered a proper and close return, from an operation by the old method, conducted by skilful workmen familiar with every manipulation pertaining to the same, and furnished with apparatus perfected in every particular by practical and great experience in the use thereof. With this result I might be content to compare that of my *third* operation, which exhibits a loss of three-fourths of an ounce per thousand. And it will compare advantageously with the experiment reported by said director, if proper allowance be made for provisional adaptation of apparatus not designed for the process, for the inexperience of workmen in the use of my method, and for the necessity entailed on me of resorting to the use of refining by fire to finish my work, after it was excluded from the separating apparatus. But the want of sagacity and care, which characterizes the experiments made in the mint by said director, to test the comparative merits of the two methods of refining, render them an inadmissible basis for a definitive conclusion, and demand that other data be brought to bear upon the question.

38. During the period I held the office of melter and refiner of the

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mint in Philadephia, my adjusted accounts show the following gold wastage:

From May 26th to Dec. 31, 1846, on	101,120.023	standard ounces	46.446	ounces.
Do. Jan. 1st do. 1847, on	1,183,565.104	do.	322.998	do.
Do. do. do. 1848, on	272,626.439	do.	111.660	do.
Do. do. to Nov. 30, 1849, on	672,586.981	do.	238.823	do.
	2,229,898.547		719.927	

39. This apparent wastage differs from the actual in the following respects:

First. It was, as it still is, the practice of the assay office of the mint not to report fractions of a thousandth in fineness, less than a half, for the credit of depositors, and debit of the melter and refiner; the quantity of gold delivered to the melter and refiner was, therefore, greater than that with which they charged him in account—to the extent of the average of such fractions—say, two tenths of a thousandth, 0.0002; except during the year 1847, when the work of the mint was chiefly that of recoining sovereigns, napoleons, and other gold coins. Rejecting this year, the above results should be increased by the sum of 209.266—being the two-tenths of 2,229.898—less the two-tenths of 1,183,565.104; adding, therefore, 209.266 to 719.927, we get 929.193 ounces wastage; the ratio of which to the gold melted is about 0.00042, or one-fifth of the wastage limited by law.

40. *Secondly*. The grains and sweeps of the deposite meltings, which were then made in the furnaces of the melter and refiner, went to the credit of his account without a corresponding charge, and to their full extent further masked his wastage. If we take the year 1849 alone, the only year of my refining California gold, and add two-tenths of a thousandth, of 672,586.981, being 134.517, to 238.823, the wastage would be 373.340 ounces. The ratio of which is 0.00055, or between five and six-tenths of a thousandth, to be increased, however, to the amount of the grains and sweeps from the deposite meltings.

41. The value of the grains, &c., from deposite meltings, in charge of the assayer, deposited to the credit of the treasurer, for the use of the contingent fund, were, according to a memorandum furnished to me by the director, as follows:

1850, February	22	- - -	$2,520 48
" May	4	- - -	3,717 21
" June	22	- - -	4,717 32
" August	29	- - -	5,063 24
" October	3	- - -	6,493 64
1851, March	31	- - -	10,699 31
" June	30	- - -	13,539 70
			$46,750 90

These $46,750 90 are equal to 2,512.861 standard ounces of gold.

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42. And as the quantity of gold operated upon by the melter and refiner from December, 1849, to July, 1851, as exhibited by his adjusted accounts, was 5,599,183.564 ounces, the ratio of 2, 512.861 to which is about 0.00045.

Therefore, if the deposite meltings, during the period that I was melter and refiner, were conducted with care and skill like that which is now exercised, my gold wastage account must have been masked to the extent of 0.00045, by grains from the deposite meltings, then always made in my furnaces; so that my gold wastage of 1849 would be as follows:

Ratio of 238.823 to 671,586.981 - - - -	0.00035
Add 0.0002 not reported by assayer - - -	0.00020
Add 0.00045 grains from deposites - - -	0.00045
	0.00100

And as in this estimate there is no account taken of the sweeps, from the deposite meltings, delivered then without charge to the melter and refiner, as is still the practice, it follows that my actual gold wastage for 1849 could not probably have fallen below, if it did not exceed, one-thousandth.

43. To determine the effect upon the apparent wastage of the melter and refiner of the sweeps delivered to him without charge from the deposite meltings, we have the following data:

The gold wastage of James C. Booth, melter and refiner, exhibited in his accounts, is, according to a memorandum furnished to me by the director:

From Dec. 1, 1849, to Dec. 1, 1850, of	3,084,378.210 ounces.....	688.773 ounces.
Jan. 1, 1850, to July 19, 1851, of	2,514,805.354 "	635,167 "
	5,599,183.564	1,323.940

The sweeps credited to his account were, according to another memorandum similarly furnished:

1850, May	9, by sweeps	71.100	ounces.
" Sept.	30, "	496.796	"
" Dec.	31, "	782.792	"
1851, June	30, "	1,075.197	"
		2,425.885	value $45,132$\frac{75}{100}$.

As new crucibles are used when gold is melted for assaying, the quantity of metal absorbed or imbibed by the pores of these crucibles, and which goes with them into the sweeps, must be greater than the quantity subsequently absorbed when the gold is melted in the refining department, in a crucible which may have been employed for many repeated meltings, and the pores of which have become saturated. Now, as the gold is melted three times in the successive operations of granu-

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lating, toughening, and ingot casting, we may fairly assume that of all the gold sweeps, one-fourth are due to the deposite melting. The one-fourth of 2,425.885 ounces is 606.471; the ratio of which to 5,599,183.564 is 0.0001 nearly, which is, therefore, the increment or correction to be added to the apparent gold wastage of the melter and refiner, to free it from the masking effect of sweeps from deposite meltings, delivered to him without charge.

44. The ratio of the wastage, 1,323.940, exhibited, as aforesaid, by the accounts of J. C. Booth to 5,599,183.564, the number of ounces charged as having been delivered to him, is 0.000236; to which add 0.0001, the correction for sweeps from the meltings of deposites, and we obtain 0.00033, the apparent rate of his wastage. Add, therefore, to this 0.0002, the average of fractional deductions not reported by the assayer to the credit of the depositors, and we have 0.00053, as the probable rate of the actual gold wastage of the melter and refiner during the year 1850 and the first half of 1851.

45. It is very probable that his exceedingly heavy operations in the years 1850 and 1851 may have reduced the wastage considerably below the rate which would have attended smaller workings; for larger quantities expose less surface, proportionally, to loss, by infiltration into the pores of the crucibles.

46. To the assumption, that *one-fourth* of all the sweeps belong to the deposite meltings, it might be objected that the melting of clippings is another of the operations of the melting department, in which sweeps are produced. This, however, may be disregarded, as the following data will prove.

The proportion of clippings returned from ingots delivered was, as exhibited in my adjusted accounts:

	Ounces of clippings.	Ounces of ingots.
In 1846 - - -	527.000	1,466,729.90
In 1847 - - -	482.000	1,336,663.00
In 1848 - - -	211.000	613,273.60
	1,220.000	3,416,666.50

The ratio of these numbers is 0.35707. And, as clippings result from ingots made from clippings, it follows that the metal is again and again, in part, returned, and the clippings from any given quantity of bullion will be expressed by an infinite series, of which the ratio is 0.35707. If we represent this ratio by r, and suppose 1,000 ounces to be the original quantity of bullion,

$$1{,}000\left(\frac{1}{1-r}\right) = 1.553$$

will be the expression of the series, and 553 ounces the sum of the clippings produced. One-half of all the bullion deposited is, therefore, the approximate aggregate of the successive clipping meltings.

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And admitting that this work is an element to be considered, then, as the meltings for assay of deposites are, to those of the melting department, as one to three and a half, or as 2 to 7, we must allow *two-ninths* instead of *one-fourth* of the sweeps to belong to the deposite meltings; and 539.085 ounces will be the correction to be made instead of 606.781 ounces, as above. The ratio of 539.085 ounces to 5,599,183.564 is 0.000096, a fraction differing so little from 0.0001 as to establish the truth of the assertion, that it is immaterial whether or not we take into consideration the clipping meltings.

47. During the year 1847, the gold bullion deposited at the Philadelphia mint consisted chiefly of sovereigns, napoleons, and other European coins; these were generally received by the treasurer and delivered to the melter and refiner without actual assay. The apparent wastage of that year must therefore have been comparatively free from the masking effect of the fractional deductions made in the assay office, and from that caused by the grains and sweeps from the meltings of deposites. The quantity of gold charged to me for that year having been, as above stated in section 38, 1,183,565.104 ounces, and the apparent wastage, 322.998 ounces, the ratio of these numbers, or of said apparent wastage, is 0.00027. Yet even this ratio is masked, to the extent of the effect of said deductions and additions, from the meltings and assays of all such deposites as may have been actually assayed. If we add to it 0.0001 for sweeps from deposites, 0.00045 for grains therefrom, and 0.0002 for deductions of assay, we obtain 0.00102, as a probable actual wastage of ordinary work.

48. Although I have demonstrated, by the above reasoning, that the actual gold wastage of the melting and refining department of the mint probably amounted to about one ounce per thousand, previously to the recent heavy refinings of very large quantities of California gold, and that these have been attended with a wastage of rather more than one-half of an ounce per thousand; and, although the aforesaid experiment, reported by the late director in his letter of May 9th, 1851, gives six-tenths of an ounce per thousand, as, in his opinion, the wastage of an operation by the method employed in the mint; yet, in conformity with the course I have uniformly observed, in all matters involving pecuniary questions arising in my proceedings, to adopt the view most favorable to the mint, I have claimed in my statement of the account of my workings an allowance or credit for wastage, at the rate of only 0.00033, or one-third of an ounce per thousand; the same being, as mentioned in section 44, the apparent rate of gold wastage of the melter and refiner for the year 1850, and one half of the year 1851, corrected for sweeps from deposite meltings delivered to him without charge, but left masked by the usual fractional deductions made in the assay office from deposites. My operations may therefore be debited in account with the aforesaid apparent wastage of 21.606 ounces of standard gold, value $401 97—see section 28; and credited with 4.578 ounces of standard gold, value $85.17; which is an allowance at the aforesaid rate of 0.00033 upon 13,873.092

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ounces, or, upon the whole amount of standard gold delivered to me, 13,914.972 ounces, less 41.88 ounces, contained in 42.88 gross ounces, or the lump of lot No. 1, which solidified as above mentioned—see sections 6 and 26, and No. 25 of the Appendix—and was therefore returned without being subjected to the refining process.

49. Under an equitable view of my agreement with the Department, I might be considered free from obligation to make good an inordinate apparent wastage, caused by accidental spilling of metal; for, although displaced and scattered thereby, it would be subsequently recoverable; and, therefore, may not be finally lost to the mint. And as I was very unexpectedly interrupted in my work, though for considerations alleged to be founded on the probable public obligations of the mint, I might reasonably claim to have been thereby absolved from liability for such wastage; yet I have preferred to admit that liability to the fullest extent, and in the statement which I have made to credit every debateable matter, although more than I believed could be justly demanded of me.

50. But in so doing, I have not designed to preclude myself from discussing the comparative merits and wastage of the two methods of refining in question, with the most rigid scrutiny and thoroughness; nor from a further investigation thereof, based upon data, or information not now possessed by me, but which may be acquired or received.

51. With reference to the comparative wastage of silver by the two methods of refining argentiferous gold, it was conceded by the director of the mint that my method, as it dispenses with silver and substitutes zinc for quartation, must save all the wastage to which the silver added in the old method is necessarily exposed.

52. And as the weight of silver required would have been 28,178 ounces for the 14,089 gross ounces of gold bullion refined by me, if used in the proportion of 2 to 1, now practised in the mint; it was, consequently, conceded by the director that my operations are entitled to an allowance or credit for silver wastage avoided or saved by them, upon 28,178 ounces. But, as it was deemed impracticable, both by the director and myself, readily to determine, by experiment, the rate of said silver wastage, it was agreed that—as refining, which comprises not only the melting, but also the solution in acid, of the silver employed, cannot be less, and must certainly be more, wasteful than the simple melting thereof—I would be fully entitled to claim for my operations an allowance or a credit, according to the average rate of silver wastage, exhibited by the adjusted accounts of the melter and refiner, upon silver bullion delivered to him and melted into ingots for coining.

53. To ascertain said average rate of silver wastage, reference must be made to the adjusted accounts. Now, those of my predecessor, Dr. J. R. McClintock, show the following allowances for silver wastage:

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For 1839, on	2,088,098	ounces	2,727.8 ounces.
" 1840, on	1,483,374	"	1,120.8 "
" 1841, on	814,694	"	390.6 "
" 1842, on	2,062,412	"	981.2 "
" 1843, on	3,340,513	"	3,301.1 "
" 1484, on	1,375,485	"	628.9 "
	11,164,576		9,150.4

Upon the remaining silver workings by Dr. McClintock, during the year 1845 and part of 1846, his adjusted accounts do not show any allowances for silver wastage.

54. During the whole period of his tenure of office, he never claimed or received an allowance for gold wastage. And when he finally settled his account with the treasurer of the mint, in May, 1846, he paid to that officer the following surplus over the amount charged to him in account:

In gold - - -	$4,943 71
In silver - - -	2,172 98
	$7,116 69

55. These facts, that the melter and refiner of the mint had not required any allowance for gold wastage, nor any for silver wastage during the last year and a quarter of his official term, and that a surplus of $7,116.69 had accumulated in his hands, are explained by the practice which had been followed of sequestrating sums of silver and gold, when the amount of either contained in any deposite of the other was less than five dollars, after deducting charges for refining, and for which sums they did not allow any credit to the depositor, nor make any debit in the account of the melter and refiner.

56. This practice of sequestration is still followed—but the bullion now so sequestrated is charged in account to the melter and refiner; yet the depositor is not paid for it.

57. The aforesaid modification was made a few months after I became melter and refiner of the mint, and was designed to prevent such accumulations of surplus thereafter.

58. During the years 1846 to 1849, there were sequestrated from deposites, in sums which would be less in value after deducting charges than five dollars each, charged to me in a petty account kept for the purpose in the treasurer's office, and by me returned to the account of profit and loss, and to the augmentation of the contingent fund of the mint:

In 1846, of silver	319.20	ounces standard,	or	$371 43
In 1847, do.	149.56	do.	or	174 03
In 1848, do.	995.05	do.	or	1,158 92
In 1848, of gold	28.07	do.	or	522.23
				$2,226 61

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59. By a memorandum furnished to me by the director of the mint, it appears that the following sequestrations of silver have also been made:

1850,	March 30,	parted for the mint	3,186.747 ounces.
"	June 29,	do.	3,965.158 do.
"	Sept. 30,	do.	3,507.700 do.
"	Oct. 31,	do.	4,055.390 do.
"	Dec. 31,	do.	5,605.290 do.
1851,	March 31,	do.	29,960.750 do.
"	June 30,	do.	15,783.560 do.
			66,064.595 ounces.

The value of these 66,064.595 ounces is $76,875.16, which sum has doubtless been passed to the contingent fund of the mint.

60. The above facts serve to show how completely the wastage of the melter and refiner must formerly have been masked by deliveries to him, without charge, of bullion sequestrated in sums less than five dollars in value, and in conformity with a practice supposed to be authorized by, and founded upon, a strained interpretation of the meaning of the word "advantageously," used in the proviso to section 14 of an act of Congress, approved January 18th, 1837, taken in connexion with the power given by section 18 of the same act, and the appropriating clause for contingent expenses of the mint, therein contained.

61. Notwithstanding the aforesaid deliveries of sequestrated bullion without charge, it appears that for the six years, beginning with 1839 and ending with 1844, the melter and refiner received allowances for silver wastage amounting to 9,150.4 ounces, on 11,164,576 ounces, charged as delivered to him. And his apparent silver wastage, masked though it must have been to a considerable degree, was, therefore, for the period aforesaid, in the ratio of those numbers, or 0.00082 nearly.

62. While I was melter and refiner of the mint, the apparent silver wastage, as exhibited in my adjusted accounts, was:

			Ounces.	Ounces.
From May 26,	to Dec., 31,	1846, on	1,477,253.000	1,292.552
Jan. 1,	"	1847, on	1,353,111.599	938.599
Jan. 1,	"	1848, on	633,198.260	1,172.397
Jan. 1,	Nov., 30,	1849, on	1,213,957.943	82.043
			4,677,520.802	3,486.591

The ratio of these sums to each other is 0.000745, or very nearly three-fourths of an ounce per thousand. But from May 26th to Oct. 1st, 1846, the sequestrated silver was delivered to me, as it had been to my predecessor, without charge; so that the above apparent wastage of 0.000745, is masked thereby to some extent. After October 1st,

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1846, a petty account was kept of such silver, in which I was charged with its amount, and the silver wastage of my regular accounts became actual instead of apparent.

63. In explanation of the great disparity of the wastages allowed me for the years 1848 and 1849, respectively, it should be mentioned that there are in the cellar of the mint a number of sinks, and a deep well, designed to collect the metal carried off by the water used for washing grains and sweeps. They were cleaned out in 1849 when I resigned my office, and the silver contained in the dirt taken therefrom greatly reduced my apparent wastage for said year. That dirt had accumulated from the spring of 1846 to November, 1849.

64. The adjusted accounts of James C. Booth, melter and refiner, exhibit, as silver wastage:

	Ounces.	Ounces.
From Dec. 1, 1849, to Sept. 30, 1850, on	771,207.306	1,193.159
Oct. 1, 1850, to July 19, 1851, on	601,255.940	388.791
	1,372,463.246	1,581.950

The ratio of which apparent wastage is 0.00114, or $1\frac{1}{7}$ ounce per thousand.

65. Since the work of the melter and refiner became, in 1849, and has continued to be, chiefly that of refining gold brought from California, a much larger proportion than was formerly required and employed of the silver bullion fund kept there on deposit by the Secretary of the Treasury, has been used as material for refining argentiferous gold; the silver bullion being successively melted and remelted with half of its weight of the gold in the operation, technically called quartation, which is one step in the process ordinarily used at the mint for the parting or separation of silver from gold.

66. To protect the silver bullion account of the melter and refiner from an apparent wastage exceeding that allowed by law, the following practice was therefore adopted, shortly after Professor Booth came into office, and is still pursued. Depositors of California gold bullion are charged with two per cent. of silver alloy for gold coins, not that so much silver is actually put into gold coins as alloy, nor that it is desirable to use such a proportion for alloy, but because it is not practicable, by the method of refining now employed in the mint, to extract all of the silver originally in such gold.

67. Of the 11 or 12 per cent. of silver, by weight, which California gold usually contains, the process employed leaves unextracted from $1\frac{1}{4}$ to 2 per cent., or perhaps, on an average $1\frac{2}{3}$ per cent. Hence depositors are charged with two per cent., and this is credited to the silver account of the melter and refiner; the difference between 2 per cent. allowed to him, and $1\frac{2}{3}$ per cent., the average left in the gold, gives him the margin of one-third of one per cent. to mask his actual silver wastage.

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68. It would, however, I believe, be impossible to determine by any reasoning upon the data known to me, what has probably been *the actual* silver wastage of the present melter and refiner; for the reason that, from November 14, 1850, to April 1, 1851, the mint could not perform the work required of it; and it consequently happened that large quantities of California gold were coined, without having been *duly* subjected to the parting process for the separation of the silver contained therein; and that to compensate the heavy loss of silver thus produced, the value of five per cent., by weight, of silver was charged as alloy to the depositors of gold bullion, amounting to the sum of $42,759 84, as is exhibited by the annexed abstract from the adjusted accounts of the mint, (see No. 28 of the Appendix;) and that this five per cent. of silver, if not more, was left in the gold coins by the melter and refiner, appears by the following memorandum of credits allowed to him in account furnished to me by the director:

		Ounces.
1849, Dec. 31,	by silver used for the alloying of gold coins	484.911
1850, March 30,	" " " "	32,723.450
June 29,	" " " "	6,824.632
Sept. 30,	" " " "	7,354.380
Oct. 31,	" " " "	7,911.570
Dec. 31,	" " " "	9,127.330
1851, Mar. 31,	" " " "	45,450.000
June 30,	" " " "	10,312.500
		120,188.773

And as the value of these 120,188.773 ounces of silver, if standard, would be $139,856 02, this sum was lost to depositors and the country.

But whatever may have been the actual silver wastage of Mr. Booth, it certainly was equal to the aforesaid credits for wastage allowed to him, and amounting to 1581.95 ounces upon 1,372,463.246 ounces, charged as having been delivered to him; or the rate thereof must have been at least 0.00114, or 1¼ ounce per thousand, and it did probably exceed this. See section 64.

69. From the above reasoning it appears that my own apparent wastage, amounting to very nearly three-fourths of an ounce per thousand, is the least rate given by any of the silver workings of the mint; and, conforming to my purpose concerning pecuniary matters in the statement of my operations, to adopt those probable rates which are most favorable to the mint, I have in said statement claimed the allowance of only 21 ounces of silver for wastage, upon 28,178 ounces; being at the rate nearly of three-fourths of an ounce per thousand—which would have attended workings by the old method, but was avoided in the workings by my method; and, as the silver used for granulation in the mint is of a fineness usually exceeding 990 thousandths, the value of said 21 ounces is 26.88 dollars.

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70. The aggregate gross weight of bars Nos. 1, 2, 3, of lot No. 1, and bars Nos. 1 to 18, of lot No. 2, being 5397.64 ounces, and the standard gold contained therein being 5935.442 ounces—see Nos. 25 and 26of the Appendix—it follows that the average fineness thereof was 989.6 nearly; and assuming the fineness, which would have been obtained if this gold had been refined by the usual method, to be 983, I am entitled to claim for silver extracted by my process, and which would not have been by that usually employed, a credit in account, of 6.6 oz. per thousand, or two-thirds of one per cent. upon the aforesaid 5397.64 ounces. But, as 563.79 ounces, bars No. 3, of lot No. 3, were only of the fineness 978.1—see Nos. 28 and 32 of the Appendix—although this inferiority was probably due rather to iron derived from the plumbago crucible than to silver left in the gold, I have deducted 563.79 from said 5397.64 ounces, and upon the remaining 4833.85 ounces have claimed credit in silver at the rate of one-half of one per cent., amounting to 24.16 oz. of pure silver, worth at 129 cents $31 16. This rate of one-half per cent. being substituted for that of two-thirds, in further pursuance of my purpose to concede part of allowances that, in pecuniary questions, I might justly claim from the mint.

The statement of my workings is, therefore, made as follows:

Dr.

To materials, &c., as per memorandum of Mr. Monell -	$395.91
To materials, &c., as per memorandum of Mr. Porter -	198.33
To apparent gold wastage of 21.606 standard ounces -	401.97
	$996.21

Cr.

By refining 14,089 ounces of gold bullion at 5 cents per ounce - - - - - - - -	704.45
By assumed gold wastage at 0.00033 on 13,873 standard ounces, 4.578 ounces, value - - - -	85.17
By assumed saving of silver at $\frac{3}{4}$ of an ounce per 1,000 on 28,000 ounces, or 21 ounces at 990 fineness, value -	26.88
By saving of silver extracted, which would not have been by the method used in the mint, at the assumed rate of $\frac{1}{2}$ per cent. on 4833 ounces, or 24.16 ounces, value at 129 cents per ounce - - - - -	31.16
By balance required to settle this account - -	148.55
	$996.21

71. And I have caused a sum of money; exceeding the amount of the balance above stated, to be delivered to the director of the mint, that he may apply the same, or so much thereof as he shall find requi-

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site, to restore to the gold bullion, charged to the account of the melter and refiner, any excess of apparent wastage which may be supposed to have been occasioned by my operations. Notwithstanding that the said excess was caused, as aforesaid, only by palpable accidents, to which my method of refining is not more liable than any other; and that the interruption of my proceedings by the director might be justly deemed to have equitably absolved me from pecuniary liability for such accidents: especially, in view of the groundless apprehension expressed by the director, that the gold, which I had refined, might not be suitable for coining, and his consequent unwillingness to permit me to refine a further sum of $750,000, although this would have been accomplished sooner by my process than could have been done by the old process; and of the fact, that I was thereby deprived of the benefit of the saving, which would have enured to my workings if that needless interruption had not occurred.

And I may here remark, that if the accidents had not happened, which occurred in the working of lots Nos. 1 and 2, and the apparent wastage upon them had consequently been at the same rate as that exhibited by the working of lot No. 3, to wit, three-fourths of an ounce per thousand; then, upon the 6121 standard ounces refined of said lots, the apparent wastage would have been 4.71 instead of 15.60 standard ounces, making a difference of 10.89 ounces, worth $202.60. And instead of the above stated balance of $148.55 against my workings, there would have been $54.05 in their favor.

72. With reference to matters of account relative to my refining operations, the reputed fineness of bullion delivered and returned are by me accepted, as if the same were mathematically exact. But with regard to the question of the comparative *inherent* wastage of my method of refining gold, the degree of accuracy of the assays made in connexion with my operations is an element to be considered and fairly discussed. It will not, I presume, for it cannot be truthfully, claimed that assays made by even the most skilful and faithful assayers are absolutely correct. The gentleman who holds the office of assayer of the mint, J. R. Eckfeldt, esq., possesses not only a familiar knowledge of all the details of assaying, acquired by intelligent, practical experience, during many years, but also the qualifications of a calm physical temperament, a steady hand, and a quick eye, each of which is requisite for the extremely delicate manipulations employed. That he is, therefore, an assayer of uncommon skill is certain; yet, repeatedly, have I heard this gentleman avow his belief, that the results of the best gold assays are uncertain to the extent of 0.0002, and that greater accuracy cannot be ascribed to them.

73. During the three years and a half that I was melter and refiner of the mint, the synthetical operations of the melting and refining department were a constant and most rigid check upon the analytical results of the assay office. The gold assays were then made by Mr. Eckfeldt himself, and their uniform accuracy gave proof of his great skill, and of his conscientious performance of duties often very laborious. But

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since the quantities of California gold bullion received have so greatly expanded the work of the mint, it has been found not to be practicable for the assayer actually to make all the assays required; and several young assistants have consequently been employed to make assays under his superintendence. Implicit as is my confidence, founded upon knowledge, in his own skill, and conscientious as I believe him to be, in all that pertains to the duties and work of his office, I yet cannot extend like confidence to the work of young men, however faithfully performed, who must be, comparatively with him, novices in the extremely delicate art of assaying.

74. If, therefore, Mr. Eckfeldt cannot claim, for his own gold assays, an exactness within the limits of a probable error of 0.0002, the question, what degree of accuracy is to be ascribed to the work of his young assistants, is one which, in discussing the comparative wastage of two methods of refining—as one of these has shown an apparent wastage of 0.00077, and the other an apparent wastage of 0.0006—may admit of the answer, that the limits of probable error extend beyond those of the matter under discussion.

It is true that, by multiplying assays and taking the mean or average results, a less degree of improbability may be obtained; yet a number of errors do not constitute truth; and work requiring extreme skill, but which has not been performed by a workman known to possess that qualification, lacks the only proper basis for confidence.

75. That the aforegoing remarks are both pertinent to, and called for by, the facts concerning my refining operations, will appear from the following results of the assays of gold bullion delivered to me. (See Nos. 29, 30, and 31, of the Appendix.) *First*, as they were reported to the treasurer, and to the credit of the depositors thereof; and *secondly*, as they were reported, when repeated for verification, before said gold was operated upon by me:

Number of deposite.	Assay for depositor.	Repeated assay.	Difference of assays. Excess.	Deficiency.	
1,049	884	884.4	0.4	—	
1,053	880	880	—	—	
1,096	883.5	883.2	—	0.3	
1,097	882	881.4	—	0.6	
1,098	880.5	880.8	0.3	—	
1,099	888	888.2	0.2	—	
1,100	884	884.3	0.3	—	
1,101	911	911.2	0.2	—	
1,113	881.5	882	0.5	—	
1,225	878.5	878.3	—	0.2	
1,233	884	884.4	0.4	—	
		Sum	2.4	1.1	Mean 0.12

The fourth of the above results shows that in the assay of deposite No. 1,097, a probable error of six-tenths of a thousandth, in favor of

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the depositor and against the mint, may have been, and was probably, made. And the third, fourth, and tenth results show that, notwithstanding the adoption of the rule to make fractional deductions, deposites Nos. 1,096, 1,097, and 1,225, were received and credited to the depositors as of fineness exceeding those subsequently found by assays of verification.

Hence it is evident, that I am fully entitled to assume that the process of assaying gold bullion, as performed in the mint, is attended with an inherent and unavoidable degree of uncertainty, which, though not exceeding very narrow limits, possibly 0.0002 as an average, does yet attain in particular instances to 0.0006, or six-tenths of a thousandth. And in any investigation or experiments which may have been, or shall be, made to determine the comparative merits of my own method, and of the method now employed for separating argentiferous gold bullion, the aforesaid degree of uncertainty in assaying should not be disregarded.

76. The refined gold returned by me as belonging to lot No. 1, was assayed, both for gold and silver, with the following results, reported by the assayer to the director, and by him furnished to me:

Bar No. 1,	weighing	9.85	ounces,	993.	gold,	7.	silver.
No. 2,	"	128.90	"	991.	"	6.	"
No. 3,	"	128.81	"	991.4	"	5.6	"

Hence it appears that my method of refining, when an alloy of $2\frac{1}{2}$ parts of zinc to 1 of argentiferous gold was used, has been made to extract, of the eleven or twelve per cent. of silver, contained in California gold, all except 5.6 thousandths, or about one-half per cent.; and I am confident that this result may be excelled. I may also claim for my process—as is shown by the fineness of bars Nos. 1 to 18, of lot No. 2—that, when zinc is used in the above proportion of two and a half to one of gold, it *readily* produces refined gold of 990 fineness, or 99 per cent. And the returns of lot No. 3, in which the zinc was used in the proportion of 2 to 1 of the gold, show that the fineness of the gold was then about 983, leaving, therefore, if we disregard base impurities, such as iron absorbed from black lead crucibles, about one and two-thirds per cent. of silver in the gold.

77 The working results, therefore, verify the statement made in the specification of my patent, that by using zinc in the proportion of "two to three times the weight of the gold bullion, the refined gold bars, if the operations have been properly conducted, will be ductile and of a fineness varying from 98.5 to 99.5 per cent."

78. The black lead crucibles employed in my workings must have imparted some iron to all of the gold, except bar No. 1, of lot No. 1, which was melted in a sand crucible, and is shown by the assay thereof to have been only gold and silver; while the assays of bars Nos. 2 and 3, cast from melts made in crucibles of black lead or plumbago, indicate the presence of iron or other impurity.

79. By the silver quartation method of refining, when silver is used in the proportion of 2 to 1 of gold, as is now done in the mint, the

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average fineness of the gold obtained is, I believe, about 983; when the silver is used in the proportion of 3 to 1, as was formerly the practice in the mint, the gold is of an average fineness of 990; but the quantity and expense of the work is then so much increased, that it is considered more profitable, both for the mint and the depositors, to refine only to the fineness 983, the cost of extracting the difference of silver being greater than its value; from this defect of the old method my new method is free.

80. From November 14th, 1850, to April 1, 1851, the mint charged depositors of gold bullion for silver alloy, at the rate of five per cent., $42,759 84, (see abstract, No. 28, of the Appendix;) of that sum lost to said depositors and to the industry of our country, my method of refining would have saved $34,207.87, or four-fifths.

And from April 1st, 1851, to December 31st, 1851, it appears from the same abstract that the mint charged for silver alloy, at the rate of two per cent., $45,617 91, of which my method would have saved at least $22,808 95, or one-half.

There was also charged to the depositors of gold bullion, see the aforesaid abstract for separating or parting the silver therefrom, at the rate of five cents per ounce, and of which my method would have saved two-fifths:

Nov. 14, to Dec. 31, 1850,	$13,498.26 charged,	5,399.30 saving.
Jan. 1, to Dec. 31, 1851,	110,409 37 charged,	44.163 75 saving.
	$123,907.63	$49,563.05

If we add together these charges, and the portions thereof which my method would have saved, we obtain the result—that of the aggregate sum of $212,285.38, charged to the depositors for parting and for silver alloy, from November 14th, 1850, to December 31st, 1851, my method of refining, if it had been employed, would have saved $106,579.87, or about one half; and at the same time would have caused the work of the mint to be done with much greater despatch, and thereby also have saved much interest.

81. If the director of the mint had permitted me to refine the $750,000, which I desired and expected to have operated upon, it was my intention to have shown, and I am confident I would have so done, that gold, in any quantity, granulated on Monday may be melted into refined bars on Thursday; and this, without preventing a like quantity from being granulated on Tuesday and melted into bars on Friday; while another like quantity may be refined during the interval from Wednesday to Saturday; and so on continuously. The whole work of recovering silver, used for granulation in the present method, being dispensed with by the zinc process.

82. But as I was prevented from doing this, I will only add that, in my opinion, a small expenditure for furnaces and improved apparatus adapted to my method, such as I have contrived for the purpose, would render the capacity of the mint at Philadelphia adequate to the

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refining of gold bullion at the rate of one million per day, and at a cost for labor and materials not exceeding about the one-half of that incurred by the process now employed; and without subjecting the workmen of the mint, and the inhabitants of its vicinity, to the injurious effects of such large quantities of noxious gases, as are incident to the present method of refining by the use of silver for quartaation.

83. In conclusion, I submit, and ask to have it borne in mind, that I have not wished to derive any benefit from my patented process of refining gold, without its superiority over the method now employed in the U. S. mint, being first conclusively established, by a series of large working operations, conducted and reported upon by skilful, careful, disinterested, impartial, and truthful persons; and that I would not receive any measure of compensation, for the said right, that was not founded upon and justified by its usefulness and value, so or otherwise as satisfactorily established.

Very respectfully, your obedient servant,

RICHARD S. McCULLOH.

Washington, August 3, 1852.

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APPENDIX.

(1.)

PHILADELPHIA, *April* 27, 1852.

MY DEAR SIR: Will you do me the favor to reply to the following questions:

1. In what capacity, and for how many years, were you employed in the mint; and what were the services which you rendered me in my recent refining operations?

2. What was the course of my proceedings, and what the results shown by them relatively to the efficiency and economy of my modes of granulating and refining gold bullion?

3. If you know of any difficulties or accidents which occurred in my operations, what were they?

4. From what you witnessed of my mode of refining, what is your opinion, as to its adaptation to the working of large quantities of metal with economy and despatch, in comparison with the old method, now used in the mint?

5. What do you believe to be the reason of the discrepancy between the results from fluxing sweeps, obtained respectively by Mr. Hare, of the assay office, and yourself.

Yours, very truly,

R. S. McCULLOH.

MARTIN SUMMERS, esq.

(2.)

PHILADELPHIA, *April* 29, 1852.

Mr. McCULLOH.

DEAR SIR: In compliance with your request, I hasten to answer the questions propounded by you to me, in your favor of the 27th instant; and, in doing so, it gives me much pleasure to give my opinion of your method of refining gold.

I was employed in the mint for about twenty-seven years, and was foreman in the melting and refining department, I believe, for twenty-three years. I also worked in the adjusting room for about two years.

I aided you in your late experiments, first, by taking charge of the granulations for you, as they were made, and seeing them properly carried to the separating rooms; afterwards I melted the gold (when refined) into bars; alloyed and made ingots for coining of some of them, and then gathered the grains and refined them upon bone-ash tests for you. I also fluxed samples of sweep.

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During the month of January, you were employed in constructing furnaces and apparatus; afterwards, with refining and gathering grains. The granulations made by your method were far superior to those made in the old way, or by hand; being much smaller, and therefore more quickly and thoroughly acted upon by the acids. The labor required is much less; and, as dipping is avoided, there is no spilling of metal to produce waste. The gold refined by you, with zinc, was as good as that refined with silver; it made ingots for coining of the best quality, and it toughened with all ease. I never saw better gold. Your mode of refining substitutes zinc for silver, and sulphuric acid for nitric; which must, I believe, make it more economical.

You had some difficulty in getting the valve of your granulating pot to work rightly; and an accident happened in your second granulation, which caused the metal to fall on the floor of the cellar, and fly around to some distance, upon the walls and other objects.

I am satisfied that your mode of working is far preferable to that in use; that much larger quantities of metal can easily be worked by it, with less labor, and in less room, as well as with less expense and waste. The furnace I used in fluxing sweep had more draught than that used by Mr. Hare; consequently, the flux was more fluid. They were all weighed by Mr. Hare.

Your most obedient servant,

MARTIN SUMMERS.

(3.)

PHILADELPHIA, *April 27th*, 1852.

DEAR SIR: If you recollect the course of my late proceedings in the mint, please to state what they were, what you had to do with them, and by what authority you acted.

2. If said proceedings have caused you to know, what are the merits of my method of refining gold with zinc, as compared with those of the method in use, in efficiency and economy, please to state what are the facts so known to you and relative thereto.

3. If you witnessed the operation of alloying the gold with zinc, and then granulating that alloy by letting it flow directly into water from the furnace I employed, please to state whether the granulations so made were attended with any perceptible volatilization of metal, and with more or less wastage than if made in the usual way; and whether my mode of granulating is, in any respect, superior to that heretofore used.

4. If you know of any accident having befallen my experiments, be pleased to state your knowledge thereof.

5. If my mode of conducting my process differed materially, from that employed in the experiments upon refining with zinc, previously performed in the mint; please to state what the difference was, and what the results due thereto.

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By replying to the above inquiries, at your earliest convenience, you will much oblige yours, very truly,

R. S. McCULLOH.

JOHN I. MONELL, esq.

(4.)

PHILADELPHIA, *April 29th*, 1852.

DEAR SIR: I will answer your inquiries in the order you have put them.

1*st answer*. Your proceedings during the first five weeks were, I believe, the tearing down and building of furnaces; and you then also tried a small experiment upon refining gold with zinc. Subsequently, you refined a large quantity of gold which you called Lot No. 2; another large amount, which you called Lot No. 3; after which you gathered up grains, refined them on the test, amalgamated sweep, distilled quicksilver, toughened and coined some of the gold you had refined, and pulled down your granulating furnace. I assisted you in the separating room, extended to you there such facilities as you required, and kept an account of materials and labor used by you; all of which I did by order of Dr. Eckert. I also had charge, jointly with you, of the metal which you used for refining.

2*d answer*. The gold refined by you toughened well, made good ingots, and appeared to be all that is required of fine gold; your process worked readily and without difficulty, as much so as the old process; your process is more economical in labor, and from the quantities of zinc, and sulphuric and nitric acids used by you, I would estimate the economy in materials at about one-half.

3*d answer*. There was no perceptible volatilization. There can be no wastage in granulating by your method, if properly conducted; but by the dipping process, usually followed, metal drops from the crucible into the furnace and upon the floor, causing more or less wastage. Your mode of granulating is very superior to any other which I have seen; it makes the grains finer and more regular.

4*th answer*. I heard that the first experiment met with an accident, but did not witness it. In your second experiment, metal was spilled upon the cellar floor, and I saw it there.

5*th answer*. You worked, first with weak and then with strong nitric acid; but, what was done before was done, all with strong nitric acid; and the results were, that your metal was tough, instead of brittle.

Yours, respectfully,

JOHN I. MONELL.

Mr. R. McCULLOH, *Princeton*.

(5.)

PHILADELPHIA, *April 27th*, 1852.

MY DEAR SIR: Will you do me the favor to give me a statement, in writing, embracing the following particulars:

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1. What were my proceedings lately at the mint; what had you to do with them, and under what authority did you assist me?

2. What facts do you know concerning the efficiency and merits of my modes of granulating and refining gold with zinc?

3. Did you perceive any volatilization in the alloying and granulating; and if there was any difficulty, please to state what it was.

4. If you witnessed any accidents, what were they?

5. If you know any thing concerning gold obtained from the large test furnace, torn down by my directions, please to state your knowledge.

Yours, very truly,

R. S. McCULLOH.

Mr. Archibald Porter.

(6.)

Philadelphia, *April 29th*, 1852.

Dear sir: I will endeavor to give you the statement that you request, as near as I can recollect. You commenced by pulling down the test furnace, that was in the cellar, and building a new one in its place. You had a silver furnace taken down, and the other two repaired; you had your granulating furnace built in the place of the one you had taken down.

You refined a sample of gold with zinc which I granulated; next, you granulated several thousand ounces of gold with zinc, which you refined, and then you gathered up your grains. As foreman of the melting department, I gave you all the facilities you required, and assisted you in the granulating; I melted, stirred, and skimmed the metal for you; I did so by orders of Dr. Eckert, the director.

Your way of granulating makes very uniform granulations, and it appears to me to be attended with less loss than our regular way of granulating, so far as dipping is concerned. The gold refined by you was good and tough, and fit for ingots.

I saw no volatilization. There was much difficulty in getting the valve to work right at first, but you had perfect control of the horizontal one.

There were two accidents; in the first, the metals were poured together; they took fire, which caused some to fly up to the ceiling and fall back upon the floor; and in the second, the metal was spilled and scattered very much over the cellar floor; it took place in changing the kettles of water.

I received several lots of grains, and melted them down, by your request and Mr. Booth's orders, which I understood from yourself, Thomas, and James Kane, that they came from the test furnace pulled down by you.

I kept a correct account of all articles used by you, while you were engaged at the mint, and furnished copies to the officers of the same.

Yours, respectfully,

ARCHIBALD PORTER.

Mr. R. S. McCulloh.

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(7.)

PHILADELPHIA, *April 27th*, 1852.

DEAR SIR: Will you do me the favor to reply, in writing, to the following questions:

1. What assistance did you render me in my late experiments at the mint, upon refining gold with zinc, and by whose orders did you act?

2. How did the process work, both in the granulating and in the acid; if there was any difficulty, or any accidents, which occurred, to your knowledge, what was it, or were they; and what was the quality of the gold refined?

Yours, very truly,

R. S. McCULLOH.

Mr. JOHN McCONN.

(8.)

PHILADELPHIA, *April* 28, 1852.

DEAR SIR: I assisted you in the refining room; in putting down the metal in the lead vats with the vitriol; also in the sweetening or filtering of it; and assisted in taking the silver up with the nitric acid, in the porcelain jars. I assisted in preparing the furnace for granulating, luting and fixing valves, by your request, and tapped the metal out for granulating, when ready; because I was accustomed to working gas apparatus, and understood the fixing of retorts and valves. I assisted in the cellar to remove the vessels and granulated metal. I acted by orders of Mr. Monell, the foreman of the refining department, and understood from him that the director had told him, that you were to have all the assistance which was required. The process worked well in the granulating, likewise in the acid; there was a difficulty in the valves, which we got over by a little experience, and got them to answer the purpose well. An accident occurred in the cellar, where we had the vessels placed to receive the granulated metal; one vessel was not large enough, and by taking it away to put another in its place, the metal happened to spill on the [floor,] but afterwards we got hogsheads to hold the metal, all at one time, without moving, and had no trouble after so doing. The metal was fine, and made good toughened bars. Yours, respectfully,

JOHN McCONN.

Prof. R. S. McCULLOH.

(9.)

PHILADELPHIA, *April* 27, 1852.

DEAR SIR: Will you oblige me by answering the following questions:

1. What had you to do with my late refining of gold with zinc, in the mint; and by what authority did you aid me?

2. How did the process work, and what was the character of the metal?

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3. If any accidents happened to your knowledge, what were they; and if there was any peculiarity in my mode of conducting the process, what was it, and what were the effects?

Yours, very truly,

R. S. McCULLOH.

Mr. THOS. CLARK.

(10.)

WEST PHILADELPHIA, *April* 28, 1852.

DEAR SIR: I received yours of yesterday asking me questions in regard to your late experiments at the mint, and without delay proceed to answer.

1. I aided you in working the metal in both the sulphuric and nitric acid, and in watching at night. And I assisted my father-in-law, Mr. Summers, in toughening the gold after it was refined. I did so by order of the foreman of the refining room, Mr. Monell, who said he was authorized, by the director of the mint, to render you such assistance as you needed.

2. The process worked satisfactorily, and the gold was good; it toughened, and made ingots for coining, without any difficulty whatever.

3. I heard that accidents had happened, but was not present, and cannot, therefore, state the particulars. You had a peculiar granulating furnace, which made the granulations much better; and you worked the metal with two kinds of nitric acid, one diluted and the other strong, which made the metal toughen without difficulty.

Very truly, yours,

T. L. CLARK.

Prof. R. S. McCULLOH.

(11.)

PHILADELPHIA, *April* 27, 1852.

MY DEAR SIR: Will you please to state what you had to do in connexion with my late experiments upon refining gold in the mint; what you know of the quality of the metal so refined; what accident or accidents happened to your knowledge, if any; and what were the advantages of my mode of granulating, in comparison with that previously and now employed?

Very truly, yours,

R. S. McCULLOH.

TOWNSEND YEARSLEY, esq.

(12.)

PHILADELPHIA, *May* 4, 1852.

DEAR SIR: In answer to your request that I would state, what I had to do with your late experiments upon refining gold in the mint: on the 5th of February, I assisted you at the granulating furnace in the

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melting room, and in the cellar beneath, until the first granulation was made; then went into the refining room and took charge of the metal for you, personating you in your absence. The quality of the metal refined by you appeared to be very good; experienced workmen, there, stated in my presence that they had never seen better. An accident happened in the cellar; in changing the kettles, the metal fell on the floor of the cellar. The advantages of your mode of granulating are great; the granulations were much finer, evener, and presented more surface for the acid to act upon, than those which I saw made by the present mode; there is no loss of metal by spilling it into the fire and on the floor; and a much larger quantity of metal may be worked with much less labor.

Very truly, yours,

T. YEARSLEY.

R. S. McCULLOH.

(13.)

PRINCETON, *May* 5, 1852.

DEAR SIR: Will you oblige me by answering the following inquiries concerning my late proceedings in the United States mint:

1. Do you know how I was occupied during each of the months of January and February last; if so, please state what you know of my proceedings, and if you had any thing to do with them, state in what capacity, and what it was.

2. Do you know any thing concerning certain gold grains, or dirt, reported to have contained gold, gathered from a cupelling furnace, torn down in the mint by my direction; if so, please state your knowledge; and if you, or others acting under you, did any thing in relation thereto, state what you, or they, so did.

3. Did you, or did you not, build or construct for me, during the months of January and February last, in the United States mint at Philadelphia, a peculiar furnace for granulating gold and zinc; and if you did, please to state what you know of the invention of said furnace; and whether the same was or was not constructed in whole or in part at the expense of the United States; and if you saw or know how said furnace worked, state your knowledge of its work; also please state, whether you had ever previously seen or heard of any furnace, or arrangements, like those employed by me, and adapted to a like purpose; and if you know what has become of said furnace, please to state what.

4. Did you, or did you not, witness any of the operations, performed by me in the mint, and forming part of the trial of a new method for refining gold; did you or did you not see any of the gold when refined, and did you or did you not form an opinion or conviction, or hear any person or persons skilled in refining gold express his or their opinion or conviction, in relation to said operations, or the merits of said method, or the quality of said gold; and if your reply to each or either

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of these inquiries be affirmative, please to state the facts in relation thereto.

5. Did you witness, or do you know, any thing relative to any accident, or accidents, which may have befallen my operations; if so, state the particulars thereof.

6. Are you acquainted with Martin Summers, and do you know what is his reputation among the persons employed in the mint of the United States and others, both with reference to his skill as a melter and refiner of gold, and his personal integrity; if you do, state what that reputation is.

Yours, very truly,

R. S. McCULLOH.

PASCAL YEARSLEY, esq., *Philadelphia.*

(14.)

PHILADELPHIA, *May* 14, 1852.

MY DEAR SIR: I have the honor to reply to your several questions as follows:

I know that you were engaged, in the month of January, in the superintendence of the pulling down of a reverborating furnace, and building of a new one in the basement of the United States mint; also in getting up machinery for a furnace, and in trying a small experiment. As master bricklayer, I was employed by the director of the mint to tear down and build the aforesaid furnaces, and by him directed to take my orders from you. During the latter part of January and early in February, I also built by your request, and on your account, in the melting room of the mint, a furnace for granulating zinc and gold, which furnace was used by you in the refining, in which you were engaged during the rest of February.

I do know, that dirt containing grains of gold was taken from the furnace torn down in the basement, which dirt and grains were delivered by the men under my direction, and at your request, to Thomas Lewellen, a workman of the mint, to be gathered into proper form.

I did build such a furnace, according to a drawing made by you in my presence, and at your expense, wholly; I saw said furnace worked by you upon several occasions, and the work done by it was pronounced by those present, skilled in the work of the mint, to be the best granulation ever done in the mint; I never saw or heard of such a furnace before; after you had done with it, I had it pulled down and removed, as requested by you.

I did witness some of said operations, and did see a large quantity of the gold refined by your process; I formed a very favorable opinion of the quality of the gold from observation of it, and comparison with other refined gold, which I had frequently seen in the mint; and I heard remarks made by experienced workmen of the mint, and by the director also, that your method of granulation was a beautiful process; and I heard the gold refined by you and your new method, spoken of

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in terms of the highest admiration by the workmen of the mint generally, and by those in the refining rooms especially. I witnessed the results of an accident which occurred in the evening in one of your granulating operations; the gold was spilled in the cellar, scattered in grains for several feet around upon the floor, splashed upon the side walls, and adhering closely to the clothes of perhaps a dozen men, who were standing round when the accident occurred; some of them had their pantaloons destroyed, and others were themselves burned; water had also been poured over the floor. I am acquainted with Martin Summers, whom I have known for years; and I know that his reputation, as a skilful workman in gold, is the very highest among the persons employed in the mint; and that he is generally reputed to be a man of the strictest integrity.

Very truly, your obedient servant,

PASCAL YEARSLEY.

Prof. R. S. McCULLOH.

(15.)

PRINCETON, *July 1st*, 1852.

MY DEAR SIR: Will you do me the favor to reply to the following additional inquiries:

Did you, or did you not, make, from the accounts of acid used by me, in my refining operations at the mint, deductions both of nitric and sulphuric acid; if you did, why were such deductions made?

Do you; or do you not, know why my refining operations were not extended to an amount much greater than they were; and if you do, what was the reason?

Very respectfully, your obedient servant,

R. S. McCULLOH.

Mr. JOHN I. MONELL, Philadelphia.

(16.)

PHILADELPHIA, *July 6th*, 1852.

MY DEAR SIR: I did make deductions of nitric and sulphuric acid; a large quantity of each, which had been delivered and charged to you, was returned by you; and for that reason, deducted from your account by me.

I know that your operations were stopped, that the public work of the mint might be carried on; and the apparatus, was required for that purpose, which you were using.

Very respectfully, yours,

JOHN I. MONELL.

Prof. R. S. McCULLOH.

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(17.)

WASHINGTON, *May* 1*st*, 1852.

DEAR SIR: In compliance with your oral request, to state in what manner I assisted you, in your recent operations at the mint of the United States, in Philadelphia, in testing the practicability of the method of refining gold bullion, invented by you, and the opinion I formed of it, compared with the old process, I have to make the following communication:

On the 11th of February, I was directed by the superintendent of weights, measures, &c., Prof. A. D. Bache, to proceed to Philadelphia, to make, at the custom-house there, certain experiments required in an investigation I was engaged upon, under his direction, at the office in this city. On the same day I received a letter (a copy of which is submitted herewith) from the Secretary of the Treasury, Hon. Thos. Corwin, introducing me to the director of the mint, Dr. George N. Eckert, and stating that, should my duties permit, and you desire my services, I was at liberty to aid you in testing your process; and that the director should, in that case, receive me as your assistant. On my arrival, I was presented to the director, who said that every means for aiding you should be placed at my disposal, and the proper persons were notified accordingly.

You desired me, particularly, to keep a memorandum of the materials used, conjointly, with the persons assigned for the purpose by the director; to make myself familiar with the details of the new process; and to note anything important that might arise in the course of the operations when you were, or were not, present in person. My duties at the custom-house occupied me during the principal part of the day, from the time I arrived in the city (Thursday morning, February 12th) until the following Tuesday; but I was with you at the mint during the afternoons and evenings. After Tuesday, until Friday night, I was there nearly all the time, my presence being then required only a couple of hours each morning, for my own duties. On Friday night I returned to Washington.

Until the time of my arrival you had been engaged, I understood, in tearing down an old test furnace, erecting new furnaces, and in subjecting your method to preliminary trials. At that time, you were also making analytical examinations of the products of each step of your process, which of course consumed much time; but the question of rapid working had not yet been entered upon.

These preliminary investigations were in such a state of forwardness on Monday morning, the 16th, that you then melted about eight thousand (8,000) ounces of gold bullion with zinc, in proper proportion for granulation. This was understood to be the first of a set of workings, on a large scale, authorized by the Secretary of the Treasury in his letter of instructions to the director. In the melting for this granulation, there was no volatilization of the alloy; the melted surface was

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perfectly bright and unruffled, all the time it was exposed to the air, previous to tapping the pot. There was a little delay in making one of the granulations in consequence of the valve in the bottom of the pot getting out of order, an unimportant accident; for, when the obstruction was removed, which did not occupy more than an hour, the granulation took place with perfect success. The grains, I observed, were remarkably uniform in their character, finer than those obtained by the old process of pouring by the hand, and much better adapted to the rapid action of acid. Besides giving this uniformity of character in the grains, your mode of granulating has the great advantage over the old one used in the mint, that none of the alloy is, or can possibly be, spilled into the furnace or upon the floor, but goes directly from the retort into the reservoir of water. You have also prevented another liability to waste, by taking the granulating water with the grains directly to the refining room, and there using the same water for diluting the sulphuric acid, which is required in the next step.

On Tuesday, the zinc was separated from the gold with dilute sulphuric acid, and on Wednesday, the gold was washed. This was a longer time than was actually required for the separation, for part of the time your attention was called to the completion of some previous workings; and the workmen had received instructions from you, not to do any thing without your presence and your express orders. On Thursday the gold was transferred to the vessels for digestion with nitric acid. The first acid employed was weak, and had been already used on the gold of your previous operations, so that it was partially saturated with silver. After this acid had become thoroughly saturated it was removed, and strong acid employed to make the gold fine and perfectly tough. Thursday and Friday were occupied, in part, with this separation of the silver and any impurities from the aforesaid gold; and you were also engaged in washing other gold in powder, drying it, preparing it for alloying with copper, or "toughening," as it is called, and running it into bars. This was completed on Friday evening. On being subjected to the usual tests by Mr. Summers, who performed your melting operations, and Mr. Porter, the foreman of the melting department of the mint, they both pronounced the refined gold, resulting from the above described operations, to be perfectly tough, and very much superior to that obtained by the process then employed in the mint. I found, on striking one bar against another, that they were unusually soft, large dents having been thus made; and in the pieces clipped off the corners of several of the bars, there was not the slightest evidence of crystalline fracture.

I obtained from Messrs. Porter and Monell the cost of the materials used by you, viz., sulphuric acid, nitric acid, and zinc, and an estimate of the cost of the labor, fuel, crucibles, fluxes, &c., presented herewith; which shows a very decided superiority of your process over the old method in point of economy. But there is every reason to believe that the rate of expense thus shown, could be considerably reduced by suitable apparatus and enlarged operations, especially when

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each workman should become familiar with the part to be performed by him. This reduction will also hold good with respect to the time required. Much time is always necessarily consumed in new methods of working of whatever kind, without direct result in the object to be attained, except in perfecting the different parts, and training the operators to work with care and certainty.

When I was with you in the mint, during the last year you held the office of melter and refiner, (in 1848–'49,) assisting you in some extra-official duties for the office of weights and measures, not completed before you accepted the mint position; you were kind enongh to give me the opportunity of studying all the parts of the old process, both before and after you had introduced the modifications and enlargement of the machinery. The apparatus now in use there, is the same you then had constructed, the only changes being in extent, and such as an increased quantity of bullion to be refined required. In comparing this old process with your zinc process, as conducted on an enlarged working scale, the facts above stated, and my impressions received during the daily progress of your operations that I witnessed, I am led to conclude, that your method of refining is susceptible of being worked more advantageously than the old method, by silver quartation, in the following particulars:

1st. In the granulation, zinc being substituted for silver, there being no liability to spill the alloy, and the time required being less than hand pouring:

2d. In the substitution of sulphuric acid for nitric acid, in separating the zinc from the gold:

3d. In the gold being perfectly tough, and fine enough to make the smallest gold coin from the first ingots after the bar meltings, which produces a saving in time and wastage; all the small gold coins now made, as I am informed by the workmen, can be made only from ingot clippings or remelted metal, thus consuming time and encountering wastage:

4th. In economy of time resulting from improvement in the mode of granulation, and from dispensing with the precipitation, washing, reducing, and melting the large quantities of silver, required in quartation, and the smaller quantity of sweep to be handled:

5th. In saving the wastage on the large quantities of silver used in the old method, and in saving the interest on this silver, as part of the material of the operation:

The machinery required to carry your process into effect would not, in my opinion, be more expensive than that now used at the mint for refining; but, on the contrary, I think it would involve less expense, as there are fewer operations required in the zinc method. The workmen having had no difficulty in carrying out your process under your direction, there is not the least doubt that they could be trained in a short time to use it, in the regular operations, as familiarly as the one to which they are now accustomed.

It gives me pleasure to be able to state, in conclusion, that every part

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of the experiments which I witnessed, was in my opinion entirely successful; and unless the report of the assayers in respect to fineness should condemn it, I do not hesitate to express my conviction that it would be to the advantage of the Government, and the commercial community, if it were adopted, and introduced into the mint of the United States, and its several branches.

Very respectfully and truly yours,

WOODS BAKER.

Prof. RICHARD S. MCCULLOH,
College of N. Jersey, Princeton, N. J.

(18.)

TREASURY DEPARTMENT,
February 11th, 1852.

DEAR SIR: The bearer, Woods Baker, esq., goes to Philadelphia under instructions of the superintendent of weights and measures, to perform certain experiments for that office, at the custom-house. Should his duties permit, and Professor McCulloh desire his services, he is at liberty to aid him in testing his process for refining gold; you will please receive him accordingly.

Very respectfully,

THOS. CORWIN.

GEO. N. ECKERT, esq.,
Director, U. S. mint, Philadelphia.

(19.)

Memorandum of expenses attendant upon a trial of McCulloh's process for refining gold bullion, at the U. S. mint, February 22d, 1852.

Quantity used 14,000 ounces, or $250,000.

7 granulations of zinc of 343 lbs. each, equal to 2,400 lbs. *a* 4 cents	$96 00
6,100 lbs. sulphuric acid *a* 2 cents per lb.	122 00
1,773 lbs. nitric acid *a* 7⅛ cents per lb.	126 32
Fuel	5 00
Labor	50 00
Crucibles, fluxes, &c.	5 00
	$404 32

Charge to depositors for refining the same quantity (14,000 oz.) at 5 cents per oz. $700.00, leaving a balance in favor of the zinc method of $295.68, as a result of this single experiment, which should not be considered ultimate. A considerable reduction of expense and time, which is of much greater consideration, could be made by perfection of machinery, worked with trained operators, and on large quantities of bullion.

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(20.)

UNITED STATES HOTEL,
Philadelphia, February 19, 1852.

SIR: Experiments were made yesterday in the melting department of the mint, the object of which must, I conceive, have been to test the applicability, to the silver quartation process, of features embraced in my improved method of granulating gold bullion to prepare it for parting, whether the same be alloyed with zinc or silver. And preparations are, I understand, now going on to try similar experiments upon a larger scale.

As it was orally agreed between yourself and me, according to my recollection, that any experiments touching the application of modes of working, used by me for my zinc process, to the old or silver process, should be tried concurrently by the melter and refiner, and myself, I respectfully submit, for your consideration, whether the aforesaid experiments and preparations are not in disregard of said agreement. But whether they be so or not, as they, I believe, infringe upon my rights, professional and legal, I hereby respectfully remonstrate against their further prosecution.

Very respectfully, your obedient servant,

RICH. S. McCULLOH.

Dr. GEO. N. ECKERT,
Director U. S. Mint, Philadelphia.

(21.)

MINT U. S., *February* 20, 1852.

SIR: I received your letter of yesterday. You complain of some trials made in the mint, in granulating gold with silver, by pouring the metal through a crucible perforated with holes, as an infraction of your legal and professional rights, and not in accordance with the understanding between us.

These trials were made at my instance, with a view to an improvement, having no connexion whatever with your patent, so far as I understand it. This reminds me of the fact, that you have omitted to furnish me with a copy of the specifications of your patent, which I deem it necessary for me to have; and as I am desirous of seeing your process fairly and fully tested, and leave you, so far as lies in my power, no ground of complaint whatever, I will suspend all action in reference to changes contemplated for the present.

Very respectfully, yours,

G. N. ECKERT, *Director*.

Prof. R. S. McCULLOH.

(22.)

OFFICE OF MELTER AND REFINER, U. S. MINT,
February 6, 1851.

DEAR SIR: Having completed my experiments on the processes for refining, so far as to form an opinion of their relative merits, I herewith submit that opinion to you.

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By the process at present pursued at the mint a sufficient amount of gold may be refined, in all probability, to meet the deposites—say as much as eight or nine millions per month; but there are objections to the process which it would be very desirable to obviate, if practicable. The process is attended with the evolution of a very large amount of noxious and disagreeable vapor, the avoidance of which I believe to be impracticable, except to a limited extent; and this vapor is not only inconvenient and injurious to the workmen, but is likewise highly objectionable to those residents of the city who are in the vicinity of the mint. The process is one of the most expensive, requiring more manual force to melt the mixed gold and silver, and to carry it through the refining process; more fuel to melt three times as much metal as there is gold in the mixture; and a large amount of the most costly of all common acids, together with a large consumption of zinc, to recover the silver employed in refining. Add to these the large amount of silver, upwards of $200,000 removed from circulation, and retained only for the purpose of refining gold. In most other points, the present process is an excellent one.

Mr. McCulloh's process consists, in the substitution of zinc for silver in the present operation, whereby a low temperature is required for melting the gold and zinc, diminishing greatly time, fuel, and labor. In the next part of the process, cold and dilute sulphuric acid is used to remove the zinc, and obtain the gold and its silver in a pulverulent state, so that the nitric acid will then remove the silver readily from the gold. So far, the process is everything that could be desired, requiring but one precaution, that is, the due regulation of the heat when melting gold and zinc together, for too high a temperature is apt to volatilize gold with the zinc. This can, however, be entirely guarded against. The only difficulty hitherto experienced, in carrying out this process, lay in the brittle character of the gold; and the difficulty of obtaining it in a malleable state, in any of the experiments hitherto made, except the last. I have not been able to obtain it in a tough condition upon a *test*, whether with or without lead or copper, nor in a black lead crucible; but it can be toughened in a sand crucible, or on a hearth of a reverboratory, whether a bone ash test or not, by the use of ordinary means.

Now, as a reverboratory can be constructed, on which several hundred thousand dollars of gold can be daily toughened, I think that the process of Mr. McCulloh is, in all respects considered, the best that could be adopted at the U. S. Mint. It is next attended with far less expense than the present method, and with no noxious fumes, and a larger amount of gold may be operated upon in the same space, and in the same time.

The process of myself and Mr. C. Morfit consists in dissolving gold by means of salt, nitre, and oil of vitriol, or by muriatic acid and nitre, in stoneware or glass vessels, by steam heat, or a sand bath, or in well-secured wooden vessels by steam blown into the liquid. Immediately after solution is effected, copperas is added to the solution to precipitate

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the gold. The gold and chloride of silver being filtered and washed, the chloride of silver is extracted from the gold by a solution of salt or an alkaline hyposulphite; or the chloride is reduced by zinc, washed, and the reduced silver extracted by nitric acid. This process recommends itself by the low cost of materials, in which respect it excels all others; by a complete extraction of silver from the gold, if necessary; by the convenience of using different kinds of vessels, according to the opportunities of procuring them; and by the use of less acid than any other process. Since, however, its use would not be a gain in the time required for refining, over the present process, and its introduction would require a total change of apparatus and arrangements in order to carry it out most successfully, attended with loss of time in making such change, I do not recommend its adoption in the Philadelphia mint. But as wooden vessels can be used with this process, and as it requires a very small amount of acid, it might be advantageously adopted in California, or where the use of much acid, or of stone or glass vessels, is objectionable on the score of expense. In such places under the above considerations, it is the best of the three processes.

In conclusion, therefore, I would respectfully recommend the adoption of Mr. McCulloh's process at the U. S. mint, since it can be introduced without interfering with the operations of the mint, and presents the advantages above specified.

Very respectfully, your obedient servant,

(Signed) JAMES C. BOOTH,
M. and R., U. S. Mint.

R. M PATTERSON, esq.,
Director U. S. Mint, Philadelphia.

(23.)

PHILADELPHIA, *February* 27, 1852.

Prof. R. S. McCULLOH,
To United States' Mint, separating department.

To 7,675 lbs. sulphuric acid, at 2 cts - - - -	$153 50
2,065 lbs. nitric acid, at 7⅛ cts - - - -	147 13
6 men, 8 days each, 48 days, at $1 80 - - -	86 40
2 tons coal for steam, at $4 - - - - -	8 00
2 bushels of salt, at 34 cts - - - - -	68
(J. I. MONELL.)	$395 71

(24.)

PHILADELPHIA, *February* 17, 1852.

Prof. R. S. McCULLOH,
To United States' mint, melting department.

February 17, to 10 bus. charcoal, at 15 cts - - -	$1 50
to ¼ of a cord pine wood, at $6 - -	1 50
to ¼ do hickory do., at $6 50 -	1 62

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February 17,	to 2 black lead pots, No. 50, at $2	- -	4 00
"	" to 1 do. do. do., No. 35	- - -	1 40
"	" to 1 man, five days, at $1 70	- - -	8 50
"	19, to 1 black lead pot, No. 50, and lid	- -	2 71
"	" to 10 lbs. of borax, at 65 cts	- - -	6 50
"	" to 10 lbs. of nitre, at 8 cts	- - -	80
"	20, to 1 black lead pot, No. 10	- - -	40
"	" to 1 do. do. do., No. 50	- - -	2 00
"	24, to 1 do. do. do., No. 50	- - -	2 00
"	" to 10 bushels charcoal, at 15 cts	- -	1 50
"	25, to ¼ cord of pine wood, at $6	- - -	1 50
"	26, to 1 man, one day - - - - -		1 70
"	28, to 3 sand pots, at 3 cts - - - -		09
"	" to 4 bricks, at 4 cts - - - -		16
"	" to 5 lbs. borax, at 65 cts - - - -		3 25
"	" to 5 lbs. nitre, at 8 cts - - - -		40
"	" to 10 bushels charcoal, at 15 cts - -		1 50
March	1, to 8 lbs. borax, at 65 cts	- - -	5 20
"	2, to 10 bushels charcoal, at 15 cts -	- -	1 50
"	3, to 8 lbs. borax, at 65 - - - -		5 20
"	3, to 10 bushels charcoal, at 15 cts -	- -	1 50
"	3, to ¼ of a cord pine wood, at $6	- -	1 50
"	4, to 3 pair gloves, at 75 cts - - - -		2 25
"	4, to 2 lbs. lead, at 4 cts - - - -		08
"	4, to ⅓ bus. bone ashes, at $3	- - -	1 50
"	5, to 1 wrought-iron pot, 107½ lbs	- - -	1 07
"	5, to 1 black lead stirrer - - - -		30
"	10, to 6½ lbs. mercury, at 90 cts	- - -	5 85
"	10, to 16 bush. Cumberland coal, at 22 cts	-	3 52
"	11, to 10 bush. charcoal, at 15 cts	- - -	1 50
"	11, to 1 black lead pot, No. 14	- - -	56
"	11, to 1 sand pot - - - - - -		03
"	11, to 1 man, one day - - - - -		1 70
"	11, to 3,051 lbs. zinc, at 4 cts - - - -		122 04
			$198 33

(Archibald Porter.)

(25.)

Operation No. 1, in account for gold.

Dr.

	Standard weight.
To part of deposite No. 633, weighing 346.12 ounces, 885½ fineness,	340.543 ozs.

Contra Cr.

By lump from crucible	do.	42.88 ozs.	at	879	do.	41.880 "
By bar No. 1	do.	9.85	"	993	do.	10.868 "
By bar No. 2	do.	128.90	"	991	do.	141.933 "
By bar No. 3	do.	128.81	"	991.4	do.	141.891 "
By grains	do.	3 53				3.530 "
By balance, wastage, and in sweeps						0.441 "
						340.543 "

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This operation was attended with accidental spilling of metal upon the floor of the melting room. A larger number of crucibles, than ordinarily, was employed for the meltings and fluxings, each of which would imbibe particles into its pores; when these facts are taken into consideration, the apparent wastage is not unusually great. The 3.53 ounces of grains are estimated as of standard, because when they were to have been melted for assay, the crucible broke, and they were spilled into the fire.

(26.)

Operation No. 2, in account for gold.

DR.

		Ounces.	Fineness.	Standard ozs.
Feb. 5	To deposite 1051	1,219.31	892.5	1,209.149
Feb. 5	To deposite 1052	733.41	897.0	730.965
Feb. 6	To deposite 1048	1,212.98	884.0	1,191.416
Feb. 6	To deposite 1050	750.60	883.5	736.839
Feb. 11	To deposite 1097	1,197.38	882.0	1,173.432
Feb. 11	To deposite 1098	798.10	880.5	780.808
	CONTRA—CR.	5,911.78	.....	5,822.609
April 1	By bars Nos. 1, 2, 3, 4, 5, 8, 10, 16, 18	2,768.41	989.2	3,042.790
April 1	By bars Nos. 7, 11, 12, 13, 14, 15, 17	2,180.61	990.2	2,399.156
April 1	By bar No. 6	181.06	988.2	198.804
April 1	By grains marked G. Z., No. 1	103.41	959.8	110.281
April 1	By grains marked G. Z., No. 4	73.62	464.6	38.004
Feb. 21	By assays cut from bars Nos. 1 to 18	1.77	989.7	1.946
March 1	By assays cut from G. Z., No. 1	0.09	959.8	0.096
March 3	By assays cut from G. Z., No. 4	0.14	464.6	0.072
March 12	By half an assay slip 0.07 oz., from G. Z., No. 5	.....	719.1	0.028
March 12	By half an assay slip 0.06 oz., from G. Z., No. 6	.....	706.4	0.027
March 13	By half of 1.63 ounce assay slips reserved from fine gold	.....	985.5	0.892
March 13	By half of 0.98 ounce assay slips reserved from G. Z., No. 1 to 6	.....	743.0	0.405
April 1	By half of 6.95 oz. of gold in sweeps	.....	1,000.0	3.861
April 1	By half of 12.94 ounces, in grains, G. Z., No 5, from furnaces	.....	719.1	5.170
April 1	By half of 12.28 ounces amalgam, G. Z., No 6, from sweeps	.....	706.4	4.819
Apri 1	By half of 1.62 ounces dirty grains	.....	671.0	0.604
April 1	By half of 0.90 ounce gold assay slips	.....	985.5	0.493
April 1	By balance or apparent wastage	.....	.....	15.161
		.....	.....	5,822.609

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(27.)

Operation No. 3, in account for gold.

		Dr.	Ounces.	Fineness.	Standard ounces.
Feb.	16	To deposite 1100	767.18	884	753.541
"	16	" 1096	1,193.47	883.5	1,171.590
"	16	" 1101	780.79	911	790.333
"	16	" 1099	1,205.37	888	1,189.298
"	16	" 1053	1,216.97	880	1,189.926
"	16	" 1049	736.92	884	723.819
"	16	" 1233	630.35	884	619.144
"	16	" 1113	907.51	881.5	888.856
"	16	" 1225	333.32	878.5	325.357
"	16	" 1098	102.17	880.5	99.956
		Contra. Cr.	7,874 05		7,751.820
April	1	By bars No. 1	3,217.50	983.3	3,515.298
"	1	" No. 2	3,102.56	981.6	3,383.860
"	1	" No. 3	563.79	978.1	612.714
"	1	grains G. Z. No. 2	191.41	959.3	204.021
"	1	" G. Z. No. 3	14.84	649.1	10.703
"	1	fine gold in powder	0.19	982.5	0.207
"	1	zinc gold 1.10 oz. and 0.1 assay, March 11	1.20	654.0	0.872
Feb.	25	assay slips from bars Nos. 1 to 3	1.49	981.6	1.625
March	4	" " G. Z. No. 2	0.13	959.3	0.138
"	4	" " G. Z. No. 3	0.11	649.1	0.079
"	12	half of the assay slips from G. Z. Nos. 5 and 6	.....	.....	0.055
"	13	" " " reserved from fine gold and grains	.....	.....	1.297
April	1	half of 6.95 ounces of gold in sweeps	.....	.....	3.861
"	1	" 12.94 ounces of grains, G. Z. No. 5, from furnaces	.....	.....	5.170
"	1	" 12.28 ounces of grains, G. Z. No. 6, amalgam, &c.,	.....	.....	4.819
"	1	" 1.62 ounces of dirty grains	.....	.....	0.604
"	1	" 0.90 fine gold assay slips	.....	.....	0.493
"	1	balance or apparent wastage	.....	.....	6.004
					7,751.820

REMARK.—In the above account this third operation is credited with one-half only of the gold contained in the sweeps; of the amalgam, G. Z. No. 6, from the same; and of the grains obtained by cleaning the furnaces, G. Z. No. 5, &c., although it might justly have been credited with a larger proportion than operation No. 2, which was smaller.

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(28.)—*Abstract of accounts, United States Mint.*

Report of 1st *Auditor, No.* 105,120—*4th quarter of the year,* 1850.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	Silver alloy.	Copper alloy.	
Nov. 14....$2,255,202.35 Dec. 31.... 6,822,548.18	Nov. 14.....$16,045.47 Dec. 31..... 39,124.88	Nov. 14....$5,613.13 Dec. 31....13,498.26	Nov. 14....$2,844.37 Dec. 31....17,079.87	$447.72	Silver alloy 5 p. c. on and from Nov. 14.
Value....$9,077,750.53	Value $55,170.35	$19,111.39	$19,924.24	$447.72	Total.....$39,483.35

Report of 1st *Auditor, No.* 105,660.—1*st quarter,* 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	5 per cent. silver alloy.	Copper alloy.	Total.
588,234.062 oz. stand'd $10,943,889.51 value	51,067.05 oz., standard $59,423.46 value	$20,318.81	$25,679.97	$405.50	$46,404.28

Report of 1st *Auditor, No.* 106,256.—2*d quarter,* 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	2 per cent. silver alloy.	Copper alloy.	Total.
524,255.606 oz., stand'd $9,753,592.86 value	58,067.97 standard oz. $67,570.00 value	$23,255.71	$11,766.71	$734.65	$35,757.07

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ABSTRACT—Continued.

Report of 1st *Auditor, No.* 106,694.—*3d quarter*, 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	2 per cent. silver alloy.	Copper alloy.	Total.
605,895.772 stand. oz. $11,272,479.49 value	68,007.08 standard oz. $79,135.51 value	$27,304.17	$13,819.28	$861.70	$41,985.15

Report of 1st *Auditor, No.* 107, 165.—*4th quarter*, 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	2 per cent. silver alloy.	Copper alloy.	Total.
850,590.247 stand. oz. $15,824,934.82 value	97,399.74 stand'd oz. $113,337.88 value.	$39,530.63	$20,031.92	$1,244.87	$60,807.47

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(29.)

Deposite. No.	Fineness. 1000ths.	Deposite. No.	Fineness. 1000ths.
633	885½	1097	882
1048	884	1098	880½
1049	884	1099	888
1050	883½	1100	884
1051	892½	1101	911
1052	897	1113	881½
1053	880	1225	878½
1096	883½	1233	884

I certify that the fineness set opposite the above numbers respectively agrees with the fineness stated in the assayer's reports of corresponding assay numbers.

GEO. W. EDELMAN,
Treasurer's office clerk.

U. S. MINT, *April* 1, 1852.

(30.)

(*Duplicate.*)

The following is the result of the special assays of eight deposites, made as requested:

No.	Fineness.
1049	884.4
1053	880.
1096	883.2
1097	881.4
1098	880.8
1099	888.2
1100	884.3
1101	911.2

J. R. ECKFELDT, *Assayer.*

February 14, 1852.

(31.)

(*Duplicate.*)

Special assays of four deposites, or parts of deposites, as requested:

No.	Fineness.
1098	880.8
1113	882.
1225	878.3
1233	884.4

J. R. ECKFELDT, *Assayer.*

PHILADELPHIA, *Feb.* 20, 1852.

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(32.)

Assays of seventeen lots of Mr. McCulloh's fine gold, of which slips were cut off February 21, 1852, numbered as follows:

No.	Fineness.	No.	Fineness.
1	989.2	11	990.2
2	989.2	12	990.3
3	989.3	13	990.3
4	989.2	14	990.2
5	989.3	15	990.3
6	988.2	16	989.
7	990.1	17	989.9
8	989.2	18	989.
10	989.		

Assays of three lots of same, of which slips were cut off February 25, 1852, numbered as follows:

No.	Fineness.
1	983.3
2	981.6
3	978.1

J. R. ECKFELDT, *Assayer*.

(33.)

MARCH 27, 1852.

The following are the results of the assays of Mr. McCulloh's grains:

	Fineness.
1st lot of grains, (March 1,)	959.8
2d " " No. 1	959.3
2	649.1
3	464.6
4	866.8
5	719.1
6	706.4

The following are the results of assays of Mr. McCulloh's sweeps, from nine reductions; four made by Mr. Hare, and five by Mr. Summers.

Of those made by Mr. Hare, the

1st gave	199.5	milligrammes	gold,	111.	milligrammes	silver,	in five ounces	of sweep.
2d "	191.7	do.	do.	106.3	do.	do.	do.	do.
3d "	203.	do.	do.	118.5	do.	do.	do.	do.
4th "	199.	do.	do.	126.	do.	do.	do.	do.

Of those made by Mr. Summers, the

1st gave	237.	milligrammes	gold,	135.5	milligrammes	silver,	in five ounces	of sweep.
2d "	229.	do.	do.	135.	do.	do.	do.	do.
3d "	126.5	do.	do.	88.5	do.	do.	do.	do.
4th "	223.	do.	do.	153.	do.	do.	do.	do.
5th "	209.	do.	do.	132.5	do.	do.	do.	do.

J. R. ECKFELDT, *Assayer*.

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The average of the assays from Mr. Hare's reductions of Mr. McCulloh's sweeps gives 198.3 milligrammes gold to five ounces of sweep; at which rate 330 lbs. avoirdupois sweeps will contain 6.14 ounces troy of gold.

The average of the assays from Mr. Summer's reductions of same gives 204.9 milligrammes gold in five ounces; according to this result, 330 lbs. avoir. of sweep will contain 6.34 ounces troy of gold.

The average of the first, second, fourth, and fifth assays from Mr. Summers' reductions gives 224.5 milligrammes gold to five ounces; according to this, 330 lbs. avoir. of sweep will contain 6.95 troy ounces of gold.

(34.)

Memorandum of assay slips cut from gold refined with zinc.

		Ounces.	Assay.
Feb. 21	From bars Nos. 1 to 18 of lot No. 2	1.77	
25	" " " 1 to 3 " No. 3	1.49	
Mar. 1	" grains G. Z. No. 1 of lot No. 2	0.09	959.8
4	" " " No. 2 " No. 3	0.13	959.3
4	" " " No. 3 " No. 3	0.11	649.1
4	" " " No. 4 " No. 2	0.14	464.6
8	" toughened or alloyed gold bars	0.19	900.2
10	" ingots for coining	0.30	900.4
11	" zinc gold in a tube belonging to lot No. 3	0.10	654.
12	" grains G. Z. No 5 of lots Nos. 2 and 3	0.07	719.1
12	" " " No. 6 " " "	0.06	706.4
13	Six assay slips reserved by Dr. Eckert, from— grains G. Z. No. 1, 959.8 fineness; " " No. 2, 959.3 "; " " No. 3, 649.1 "; " " No. 4, 464.6 "; " " No. 5, 719.1 "; " " No. 6, 706.4 "; Mean 743.	0.64	743.
	Ten assay slips reserved by Dr. Eckert, from— 1 bar No. 6, 988.2 lot No. 2; 2 " 7, 990.1 "; 3 " 10, 989 "; 4 " 15, 990.3 "; 5 " 17, 989 9 "; Mean 989.5. 6 bar No. 1, 983.3; 7 " " 983.3; 8 " No. 2, 981.6; 9 " " 981.6; 10 " No. 3, 978.1; Mean 981.6	1.11	985.5
	From G. Z. Nos. 1 to 6, reserved by R. S. McC.	0.34	743.
	" five bars of lot No. 2, " " " 989.5	0.52	985.5
	" " " " No. 3, " " " 981.6		

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(35.)—*Gold alloyed and made into ingots.*

		Ounces.	Fineness.	Standard.
March 8	Dr. To bar No. 1, lot No. 2.....	305.17	989.2	335.427
	To bar No. 18, lot No. 2.....	309.61	989.	340.249
	To bar No. 1, lot No. 3.....	333 71	983.3	364 597
	To bar No. 2, lot No. 3.....	312.20	981.6	340.506
	To bar No. 3, lot No. 3.....	281.64	978.1	306.080
				1686.859
March 8	Cr. By assay slips from bars.....	0.19	900.2	0 19
" 10	By assay slips from ingots.....	0.30	900.4	0 30
" 12	By 24 ingots.....	1468.32	900.4	1468.97
April 1	By ingots and tops.....	209.95	900.4	210.04
" 1	By grains.....	7.61	(?)	7.61
				1687.11

REMARK.—The apparent gain of this account may be explained, by the facts, that the grains are assumed as of standard fineness, though they were probably less, and that some particles of gold, previously in the furnace, may have been gathered with this metal. But in the absence of an assay of the grains, there is no proof that the excess is other than apparent.

(36.)—*Memorandum of weighings of fine gold.*

	Lot No. 2.	Ounces.		Lot No. 2.	Ounces.
March 8	Bar No. 1.....	305.17	April 1	Bar No. 7.....	288.53
March 8	Bar No. 18.....	309.61	April 1	Bar No. 11.....	325.23
April 1	Bar No. 2.....	297.33	April 1	Bar No. 12.....	327.91
April 1	Bar No. 3.....	338.84	April 1	Bar No. 13.....	321.09
April 1	Bar No. 4.....	337.23	April 1	Bar No. 14.....	311.44
April 1	Bar No. 5.....	298.36	April 1	Bar No. 15.....	329.36
April 1	Bar No. 8.....	308.66	April 1	Bar No. 17.....	277.05
April 1	Bar No. 10.....	260.36			
April 1	Bar No. 16.....	312.85			2,180 61
		2,768 41			
	Lot No. 3.			Lot No. 3.	
March 8	Bars No. 1.....	333.71	March 8	Bars No. 2.....	312.20
April 1	Bars No. 1.....	1,282.16	April 1	Bars No. 2.....	1,203.44
April 1	Bars No. 1.....	1,601.63	April 1	Bars No. 2.....	1,586.92
		3,217.50			3,102.56
March 8	Bars No. 3.....	281.64			
April 1	Bars No. 3.....	282.15			
		563.79			

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(37.)

MINT OF THE UNITED STATES,
Philadelphia, 2d April, 1852.

DEAR SIR: Mr. Eckfeldt reports the fineness of the gold in powder at 654 m. This and the fine gold are in my possession, and will be given to you as you requested.

Very respectfully, &c.
GEO. N. ECKERT, *Director.*

Prof. R. S. MCCULLOH.

(38.)

MINT OF THE UNITED STATES,
Philadelphia, 13th April, 1852.

DEAR SIR: Among the parcels of gold returned by you, the proceeds of experiment No. 3, was one of "grains and dirt," weighing oz. 1.79. With a view to avoid a mere estimate, I directed this parcel to be melted. The weight returned was oz. 1.62; and on assay the button is reported 671 m.

Very respectfully, yours,
G. N. ECKERT, *Director.*

Prof. R. S. MCCULLOH, *Princeton, N. J.*

(39.)

PRINCETON, *Friday, April* 23, 1852.

SIR: As no other probable reason for the discrepancy between the results from fluxing the samples of sweeps, obtained by Mr. Summers, and those obtained by Mr. Hare, each having used like quantities of the same materials, can be assigned, than that it is ascribable to the different degrees of heat produced by the two furnaces, used respectively by them; and as said sweeps, composed chiefly of bone ashes, plumbago, fire clay, &c., are *more than usually* refractory, so refractory, indeed, that Mr. Summers failed to melt, except in part, one of the samples used by him, I respectfully request that you will cause to be melted and assayed two or more additional samples of said sweeps, using for the purpose the following mixture, which is more fusible than that heretofore generally employed in the mint: sweeps, 3 oz.; soda ash, 3 oz.; potash, 3 oz.; borax, fused, 6 oz.; litharge, 6 oz.; salt, 1 oz.

The borax should be such as that used by Mr. Booth in the melting department, fused and *not in crystals*, which contain about 47 per cent. of water. Mr. Summers will probably make similar fluxings, for verification, by my request.

If the sweeps, or dirt, from the large cupelling furnace, which was torn down, have been assayed, I should be pleased to have the results at your earliest convenience. If otherwise, you will oblige me by directing that they be assayed.

Very respectfully, your obedient servant,
R. S. MCCULLOH.

DR. G. N. ECKERT, *Director of the mint.*

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P. S. Permit me to invite your attention to certain remarks, which may apply to the subject of this communication, to be found in the treatise on assaying of M. Chaudet, pages 263, 264, a book which is in the assay office of the mint.

(40.)

MINT OF THE UNITED STATES,
Philadelphia, May 1, 1852.

SIR: My absence in Reading has prevented a reply to your note of the 23d instant.

I regret to say that the sweeps which you request re-assayed have been mixed with the other sweeps of the mint, so that your request cannot be complied with.

There can be no objection, however, to taking the result of Mr. Summers' smelting (excluding the one pronounced defective) as that to be reported. The ounces thus reported are 6.95.

Very respectfully,
GEO. N. ECKERT, *Director*.

Prof. R. S. MCCULLOH, *Princeton*.

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LETTER

TO THE

HON. THOMAS CORWIN,

SECRETARY OF THE TREASURY,

IN REPLY TO

A REPORT OF THE DIRECTOR OF THE MINT UPON CHARGES PREFERRED AGAINST

PROFESSOR JAMES C. BOOTH,

MELTER AND REFINER OF THE UNITED STATES MINT,

BY

PROFESSOR R. S. McCULLOH.

WASHINGTON:
GIDEON AND CO., PRINTERS,
1852.

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WASHINGTON, *August 3d*, 1852.

SIR: In the month of October last, I had the honor to receive from you a communication, dated October 15th, 1851, enclosing copy of a report from G. N. Eckert, director of the mint, dated October 14th, 1851, and informing me that the Department would, in accordance with said report, authorize a trial of my process for refining gold, to be made at the mint, in my presence, if any loss of gold which might accrue should be borne by me.

In the aforesaid report of the director, copy of which, marked A, is hereto appended, he had not confined himself to matters relative to the expediency of the trial recommended by him, but had also incidentally remarked upon charges—which I had preferred in my letter to the President, of August 1st, 1851, against Professor James C. Booth, melter and refiner of the mint—and in exculpation of said Booth.

In my reply to you, of November 13th, 1851, I, therefore, said: "for the present, I forbear from remarks on said report, except in relation to the practical question of a trial of my process for refining gold, to be made at the mint, and in my presence." It was my wish to establish the merits of said process, by successful workings at the mint, and thus to show that it is free from the objections which had been urged against it by Professor Booth, and by Dr. Patterson the late director of the mint. And, therefore, it appeared to me proper to forbear, meanwhile, from the discussion of an issue, which might preclude free intercourse between the present director and myself, during the progress of the aforesaid trial. There was a fitness in this forbearance; and in my determination to observe, towards the officers of the mint, with whom the progress of said trial might require me to hold personal intercourse, that courtesy to which their official relations would entitle them.

But the proposed trial having been made, and the results thereof being reported by me to the Department, in a printed pamphlet, herewith presented; I now deem it proper to submit, for your information, such other facts and remarks as seem appropriate and necessary; in further reply to your aforesaid letter of the 15th of October, 1851, with reference to matters apart from said trial, but alluded to by said director in his above mentioned letter of October 14th, 1851, to the Department.

In the first place I should observe that I had found it necessary to complain of the official proceedings of the melter and refiner, and other officers of the mint, in my aforesaid letter to the President, of August 1st, 1851, asking that a just trial of my method of refining gold should be made at the mint, in my presence; for the reason, that said proceedings had been, in my belief, regardless of my own rights and of important public interests; but I had neither any purpose nor any wish to pursue them further, than said rights and interests should render necessary, and less than this no one could justly expect of me.

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When I received the letter of the Department to me, dated August 12th, 1851, informing me that the director of the mint had been instructed to investigate, the charges and representations contained in my aforesaid letter to the President; and requesting me to be prepared to give said director, such information and explanations as he might require, I therefore addressed to him a letter, dated August 13th, 1851, tendering them to him.

Subsequently I went to see the director, with the purpose of ascertaining what course of proceeding he would desire to pursue, and then submitted for his consideration the suggestion that it would be proper to furnish to the officers of the mint, charged by me with misconduct, copies of said charges, with specifications of the facts upon which they were founded, which I would prepare; that a full opportunity for defence, by answering, producing evidence, confronting and cross-examining witnesses, who might be called to establish the charges, should be afforded to said officers.

To this proposition the director replied, that the manner of conducting the investigation should, he presumed, be left to himself and the Secretary of the Treasury.

He also informed me that as said investigation related to three distinct subjects, to wit, the question of the expediency of trying my aforesaid process in my presence; the charges against Professor Booth, melter and refiner; and the charges against Franklin Peale, coiner, it would most accord with his view of the public interest and with his own convenience, to dispose *first* of the question of a trial of my process; and *then* to investigate the charges against said officers separately. And, therefore, he orally requested me to furnish such information, as I deemed requisite to enable him to decide correctly with reference to said trial.

Accordingly, I addressed to the director a communication, dated September 26th, 1851, copy of which, marked C, is annexed, setting forth reasons why a trial of my process, conducted by myself, should be made at the mint; and for his information, I enclosed copies of my memorial to Congress, of February 24th, 1851, and of my letter to the Department, of February 28th, 1851.

Meanwhile the director had by letter, dated 22d August, 1851, requested, in relation to the charges preferred against Franklin Peale, coiner, in my aforesaid letter to the President, that I would "specially detail them in writing, with a reference to the particular action or actions which I might consider infractions of official duty, and to the testimony on which I relied for their proof." I furnished him, therefore, with written specifications, dated September 24th, 1851; and upon being informed, by a letter from him, dated September 26th, 1851, that his investigation of the charges against said Peale would be conducted as an administrative inquiry; and being in said letter requested to furnish the names of persons whom I wished him to examine with reference to said charges, I accordingly gave him the names of said persons, and mentioned the facts that I believed were known to them, and about which they might be interrogated, respectively.

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But in relation to the charges preferred against Professor Booth, melter and refiner of the mint, in my aforesaid letter to the President of August 1st, 1851, the director neither requested, nor has he received from me, written or oral specifications; nor did he either seek, or receive from me, any evidence to substantiate the same, except that portion which is contained in the correspondence relative to my aforesaid process, published in my memorial to Congress of February 25, 1851.

He had proposed to consult his own convenience, by investigating said charges, independently of matters connected with a trial of my process, after he should have disposed thereof; and I had acquiesced in that decision. Nevertheless, in his aforesaid report to the Department, of October 14th, 1851, advising a trial of said process, he took leave of his own proposition; and without either having extended to me the opportunity of presenting specifications, and producing testimony to substantiate the charges I had made against Professor Booth; or having made other than an *ex parte* "administrative inquiry" into or about the subjects of said charges—if indeed he made any inquiry—he presumed to report thereupon, and in so doing made exculpatory representations, which are inconsistent with the public interests and with the truth.

Concerning the charge that "the energy and working hours of Prof. Booth have been devoted rather to his private affairs, beyond the precincts of the mint, than to his public duties therein, since he was appointed to his present office;" and my reasoning, in connexion therewith, "that workmen, however skilful they may be in the performance of familiar routine operations, yet need, when improvements are to be introduced, to be guided by the officer whose science, skill, and forethought, it is by law contemplated should preside over all the work entrusted to his charge, so as to insure suitable economy and correct results; and whose habitual absence is, therefore, inconsistent with the public interest and in derogation of law," the director saw fit to report as follows:

"Of the charges against the melter and refiner for habitual absence, inconsistent with the public interests and in derogation of law, I may remark, that whether Mr. Booth be absent a greater or less time than his predecessor, I cannot pretend to say. Since my connexion with the mint, he has faithfully discharged the duties of his office, nor have I any reason to suppose that he neglected them previously. The operations of his department are conducted with rapidity, energy, and ability; and exhibit a wastage far within the legal limits of allowance."

What signification the director of the mint may have attached to the order of the Department requiring him to investigate the charges which I had preferred against his subordinate, Prof. Booth, I am at a loss to determine. But if I should inductively seek it, in his proceedings, and in the words of his exculpatory letter to you of October 14th, 1851, it would be this: that he considered himself instructed to prepare some sort of a defence of said Booth. And strange, indeed, is the defence he has made.

He begins by informing you "that he cannot pretend to say whether

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Mr. Booth be absent a greater or less time than his predecessor;" culpable, then, as I have charged that Prof. Booth is, for his neglect of his official duties, as melter and refiner of the mint, the director, when ordered to investigate that charge—without knowing or heeding upon what evidence it is based, and without inquiry concerning the manner in which the duties of that office were formerly discharged by myself, the "predecessor" to whom he refers—can only find that he "*cannot pretend to say*" whether I may not have been as bad as said Booth—as if it would prove him to be white, to insinuate that I may possibly have been black.

Certainly a peculiarity of perception must either characterize, or at the time have befallen the director, that he should thus have set up an avowal of his ignorance in relation to my comparative attention to duty, in exculpation of neglect thereof by Prof. Booth; especially when he might have fully informed himself by inquiring of persons at his elbow. And this profession of ignorance he has made to you, as if it were a fulfilment of your order, that he should prosecute an investigation and report the results thereof. If such were his ideas of an investigation, Prof. Booth may congratulate himself that it was a proceeding so mild, so unmeaning, so free from all purpose to hold him responsible for any neglect of duty, of which he had been guilty; and so ready to find for him the apology that the director "cannot pretend to say, whether Mr. Booth be absent a greater or less time than his predecessor." There would appear to be in this unpretending acknowledgment, offered as an imagined vindication, a simplicity very uncommon; and it is pleasant to find that, upon this subject, the director seems to have attained to a consciousness of ignorance, which I could wish were the beginning of knowledge.

Concerning the imputation which his remark casts upon myself, the "predecessor," and the comparison which it challenges, I affirm, and the director can neither show nor *learn* to the contrary, that the devotion of nearly the whole of my time, and my constant personal attention to the duties of the office of melter and refiner, were as well known to all the persons in the mint, and to those doing business therewith, as have the absence of Prof. Booth from the mint, during working hours, and the daily devotion of the greater part of said hours to his private business, since he succeeded to said office, been habitual and notorious.

Since the director might, therefore, have readily informed himself, by simply asking those around him concerning the time I devoted, and the personal attention I gave, to the performance of the duties of melter and refiner, he has cast upon me an unjust and false imputation. Yet he may not have intended to do this, and may not be conscious that he has done it; for the mirror of his perceptions seems to clothe things in such varied lights, shades, and colors, and to exhibit them in such distorted forms, that he might charitably be held innocent of having intentionally imputed any thing, to any body. However, when exculpating Prof. Booth, as melter and refiner, from my aforesaid charge, the director must have known—for it is notorious in the mint of the

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United States, and in the city of Philadelphia—that said Booth carries on, in a private laboratory in said city, the business of making chemical analyses, and giving instruction therein to pupils; also, that he is concerned in the manufacture of oxide of cobalt for the use of potters; and that his time is chiefly occupied in these affairs, instead of in the fulfilment of duties which he should discharge in person at the mint, but has devolved chiefly upon workmen, though in part upon a young substitute, who does not possess the scientific and metallurgic attainments, which are requisite in the person holding the office of melter and refiner.

Moreover, as the director himself had informed me, that he had sought in vain, for several days, to find Professor Booth in his apartments at the mint, I am constrained to believe that, in attempting to defend him against my aforesaid charge, said director has stated, perhaps unconsciously, what he might and should have known, and what Professor Booth, many persons at the mint, and I, do know to be untrue.

And I may here add that, after Professor Booth had accepted the office of melter and refiner of the mint, he informed me, in explanation of his apparently inconsistent conduct of having first declined to be a candidate for, and then having sought the appointment, that he would not have accepted said office, if the then director of the mint had not promised him, that he should not be required to devote his time to the duties thereof, to such an extent as would impair his private business—a communication, which, if it had been made to me previously to my having recommended his appointment, and its having been conferred upon him, would have caused me to refrain from giving it.

Nor is the manner in which the business of the melting department of the mint has been, and now is, conducted, creditable to Professor Booth, or to the mint; for it is a fact, which the adjusted accounts of its operations show, (see Appendix, table D,) that, from the 14th November, 1850, to April 1st, 1851, the depositors of gold bullion were charged full price for separating their silver from their gold, to wit, five cents per ounce, and then deprived of nearly the half thereof, to wit, five per cent. of silver, left in the gold coins by the melter and refiner, and charged to the depositors as alloy, amounting to $42,759.84—four-fifths of which should have been separated in the refining department, and would have been, if said operations had been conducted by this officer with proper "energy and ability."

This charge of five per cent. of silver alloy could not legally have been made, without the concurrence of the Treasury Department, required in relation to all charges made by the mint to depositors, by section 18 of an act of Congress, approved January 18, 1837. It was a measure which could have originated only with the officers of the mint; and their object must have been to avoid asking for, or to obviate the necessity of, additional transfers of public money to the mint; and thus to screen the inefficiency of the melting and refining department, whilst they affected to be extracting the silver from millions of dollars of gold bullion; when, in fact, nearly the half of that silver was left

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in the gold coins, notwithstanding that the depositors paid to have it separated therefrom. This was not only an injury, but a wrong, done to the depositors. And if, to legalize said injury, the requisite sanction of the Department was sought, it could only have been obtained, I presume, through a seeming necessity, and by reason of misplaced confidence.

Such, indeed, was the inefficiency of the melting and refining department of the mint, during said period, that notwithstanding the amount of the public moneys placed to the use of the mint, for the accommodation of depositors of bullion, by making advances to them, had been increased from one million to 4,841,150 dollars—with loss of interest to the United States upon this amount, at the rate of six per cent. per annum—yet, on the 31st of December, 1850, the unpaid deposites amounted to $4,220,946.36, as exhibited by the abstract of certificates, filed with the adjusted accounts of the mint, for that quarter.

Professor Booth, employing for quartation two pounds of silver to one of gold, and with a charge to the depositors of five cents per ounce, for materials and labor used in parting silver from gold, was by the late director, and is by the present director, permitted to leave, as alloy, or unextracted silver in the refined gold, a quantity equal in weight, to two per cent. of the weight of said gold; and in November, 1850, he obtained permission to leave five per cent. of unextracted silver in the gold, without any abatement from said charge of five cents for parting. Whereas, I, working with the same apparatus, and employing three pounds of silver to one of gold, and the charge to depositors being only four cents per ounce, for materials and labor used in parting, was required to extract, and did extract, all of the silver except one per cent. And when I invented, constructed, and first put that apparatus in operation; and, as an experiment, employed in quartation only two pounds of silver to one of gold, seeking thereby to economize acid, silver and labor, the result showing that one and a half per cent. of silver was left in the gold, this was deemed proof of the failure, not of the experiment, but of my new apparatus; and it was then urged that it ought to be immediately torn down, and the use of bottles resumed, if the next refining of gold, made with it, should not extract all except one per cent. of the silver from the gold; as I maintained that it would, if the usual proportion of three pounds of silver to one of gold should be employed; and as I, then, by actual work, showed that it did.

In Professor Booth's current refinings, the proportion of silver that is left in the gold, nearly two per cent., is greater than that which was deemed good cause to condemn even an experiment in mine, and which, if it had not been reduced to one per cent., in my subsequent operations, would have been considered sufficient reason for the destruction of said apparatus.

The aforesaid apparatus, which I had invented, constructed, and left ready to be used by Professor Booth, was in all respects suitable, except that it needed an additional or larger steam-boiler for operations of greater magnitude; therefore, as the quantity of work subsequently

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increased, it was only necessary to proportionally enlarge that apparatus, as was done, but with culpable delay; for Congress had, by an act of May 15, 1850, made an ample appropriation, $20,800, for this and other purposes. And Professor Booth had, therefore, no excuse for being without the necessary power to do, promptly and effectively, all the refining work required of him. Yet, by reason of the inadequacy of his arrangements, between November 14th, 1850, and April 1, 1851, when the officers of the mint were anxious to magnify its efficiency and operations, the sum of $42,759 84, in silver, is shown, as aforesaid, to have been lost to the depositors and the country, or virtually thrown away; four-fifths of which, or $34,207 87, might and should have been saved by merely enlarging the apparatus, and would have been, by a truly energetic and able officer, properly attentive to his public duties, and less engrossed with his private affairs. In this non-performance of work, notwithstanding the full charge for doing it had been exacted from the depositors, the present director may find evidence of "rapidity;" for rapid, reckless, wastful, and wrong, it most assuredly was; but if he can perceive it to be, on the part of Professor Booth, the manifestation either of "energy and ability," or of a "faithful discharge of the duties of his office;" either, is more than I can discover, or acknowledge.

And from personal observation, during my presence at the mint last winter, I know that the usual absence of the melter and refiner from its working apartments, and the consequent substitution of an unqualified assistant, or, rather, of two good principal workmen, in his place, neither of whom is legally commissioned so to give orders to and direct the other workmen, is an arrangement productive of influences inconsistent with harmonious, skilful and careful work.

The director is also mistaken, in supposing that it is true, that the operations of the melting and refining department show, that the wastage is very far within the legal limits of allowance; for credits are arbitrarily allowed to the melter and refiner, and bullion is delivered to him without charge, to such an extent that his actual wastage is so masked, that its true amount is not ascertained; and, therefore, is not exemplified in any of the accounts.

With reference to the remaining charges against Professor Booth, melter and refiner, preferred in my aforesaid letter of August 1, 1851, to the President, they were not, as softened down in the language of the director, "for unfairness in the experiments made in his department, with a view to test the practicability and expediency of Mr. McCulloh's method of refining gold;" but they were, rather, that said Booth had manifested want of integrity in that, he "failed to demonstrate *his alleged invention* to be such as he had professed it to be, *when he was bargaining for an interest in mine*," &c. I affirmed that "various experiments, designed to test the merits of the *process of Mr. Booth*, were tried *by himself* in the mint at Philadelphia. The results of which—withheld for a long time from my knowledge by him, though interrogated by me, as a party of interest, with reference thereto—were finally admitted by him, and reported by the

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late director of the mint, Dr. Patterson, to be such as to have *demonstrated* the aforesaid *invention of said Booth* to be destitute of efficiency and *therefore* of no value." And I said, "with respect to the interest of Professor Booth, 'that, as his own process proved, upon trial by himself, with every facility, to be destitute of value, he ceased to have any equitable or just claim upon mine. And that I consequently *demanded,* and *had obtained* from him, a release of the moiety of my invention, which had been conveyed to him in exchange for a moiety of his *alleged* invention."

Now these are grave charges, involving something more than mere "unfairness in experiments"—implying rather, that an officer of the mint had been guilty of a transaction, in which he sought to acquire and to hold an interest in a valuable grant, by assigning an interest in an alleged invention by himself, but destitute of efficiency and value—a transaction to which I shall not apply the term that would most aptly designate it; and which I tolerated, only while I extended to the assurances which that officer gave to me orally, and had solemnly made, in relation to the value of his alleged invention, a confidence, to which they have been proved not to have been entitled.

In relation to this grave charge, the director casually observes, that, "as to the want of value in Mr. Booth's invention, it is most emphatically denied by him." What else was to have been expected, than that he would deny it? Did the director suppose he would confess it? Certainly, if the director had reasoned from his "experience of human nature," he could not have expected such a thing. Professor Booth had in his writings both certified to the great value of my method of refining gold, and denied that it possesses such value. He had officially recommended, in writing, its adoption and use in the refining work of the mint; and, then, had subsequently written that he could not conscientiously have recommended it. What signifies, then, the aforesaid denial of a man, so inconsistent in what he states; especially, when his admission to the contrary would be his own condemnation? And what additional force does emphasis give to a denial, if it lacks the basis of truth?

Wherefore, if the director desired to ascertain the facts of this matter, did he not seek information of others, as well as of the party accused? And wherefore did he not extend to me the opportunity of furnishing proof, in substantiation of what I had charged? I was ready and prepared to establish all that I had asserted; and the facts, as I have stated them to be, I can and will prove, whenever I may be called upon to do so, if an opportunity of adducing testimony shall be properly extended to me.

Nor can Professor Booth, notwithstanding the *ex parte* proceedings and exculpatory report of the director of the mint, escape from the discredit which his acts in this matter have fastened upon him, or recover, in the esteem of honorable men, from the position in which these acts have placed him.

Not a little curious, also, is the attempt which the director has made at an argument in defence of Professor Booth. He first declares it to

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be an "undeniable fact," that Professor Booth "had a direct pecuniary interest in the successful issue" of the experiments, upon my method of refining gold, tried at the mint under his supervision. He asserts that said Booth "having become legal owner of one-half of Mr. McCulloh's patent, would have shared with Mr. McC. the sum appropriated by Congress." Then he adverts to the fact that I had already denied said interest and said ownership, for the reason that the assignment made to me by said Booth was *ab initio* void, for want of consideration, his alleged useful invention being "destitute of efficiency, and *therefore* of no value;" concerning which, the Director remarks: "I express no opinion as to the law of this view; and as to the want of value in Mr. Booth's invention, it is most emphatically denied by him; but, supposing both the law and the fact to be as stated, it is quite certain that, while conducting these experiments, Mr. Booth *believed* himself to have a pecuniary interest in their success, and must be inferred to have acted accordingly."

Now, the amount of all this is, that the "undeniable fact," of the director, is an incorrect inference from transactions, about the legal effect of which he "expresses no opinion;" that Professor Booth made an *emphatic denial* that his invention wants value; and that the director came to an abiding conclusion, that it is *quite certain* that said Booth *believed* he had an interest, and must be inferred to have acted accordingly.

Of the *emphatic denial* of Professor Booth, already somewhat discussed, I may now say, that it is without force, as it was made after he had executed a release of all interest in my process for refining gold; which release was demanded, exclusively, upon the ground, that his alleged useful invention for the same purpose is not, and never was, of any value; and which demand was made, coupled with the declaration, that unless said release was promptly given, it would be sought through a court of equity.

And of the conclusion of the director, I would first observe, that it is not generally as easy to discern with certainty, what our fellow men may or may not have believed, as it is to know what they ought to have believed. But, as the late director of the mint, Dr. Patterson, did, in his letter to you of March 18, 1851, make explanations, which he considered necessary, after seeing my published memorial to Congress of February 24, 1851; and, as the experiments tried in the mint, and deemed by said Director Patterson conclusive against my process, *were made subsequently* to his aforesaid letter; and as my above mentioned memorial did set forth, that the patented process of Messrs. Booth and Morfit "has proved an utter failure, under the management of Professor Booth himself, so that the union between us by mutual assignment, recorded in the Patent Office, has, in all probability, been without valuable consideration on their part, and would, therefore, be void in law and equity;" and as said Booth and Morfit did, upon my demand, based upon the aforegoing alleged want of consideration, release to me, in July, 1851, by an instrument of writing duly recorded, the assignment I had made to them; and as, notwithstanding all these facts, the present director seems to consider it

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"quite certain that, while conducting these experiments, Mr. Booth *believed* himself to have a pecuniary interest in their success;" therefore, I am willing to let said director entertain his opinion, and "*credat Judæus Appella, non ego;*" for my mind is so constituted that it cannot see this *certainty*, and is of little faith with reference thereto.

Upon the remarks made by the director, in his aforesaid report of October 14, 1851, with respect to the motives of the official action of his predecessor, Dr. Patterson, I have to state, that I have been informed, that this gentleman had, for some months before he resigned his office, been so unwell that he could not justly be deemed responsible for the due progress of operations in the mint; and as this may have been the fact, it would be ungenerous did I not, under such circumstances, accord to him, now a private citizen and in impaired health, the full benefit of a statement made to explain official proceedings which were wrongful to me; and of which I had, therefore, at the time to complain. But, for this wrong I do not entertain any unkind feeling towards him; and if it be true, as I believe it to be, that he acted, in these matters, rather upon the representations of subordinates around him, than upon his own investigations and unbiassed judgment, then are they the more culpable for the part they played, in that they abused his confidence, and brought upon him a measure of censure which was justly and chiefly, if not exclusively, their own.

Concerning the charges which I preferred against Franklin Peale, the coiner of the mint, and the specifications upon which they are founded, I may remark, that I believe the director of the mint has inquired into one of them—that which relates to the aggressions of said Peale upon the engraver of the mint, James B. Longacre, esq., an artist of high reputation, a worthy gentleman, and a faithful and good officer, and to the clandestine misrepresentations of the work of this gentleman, made by said Peale, in the hope to deprive him of office—and that the results of the inquiry were such as fully sustained the charge, and all I had specified in relation to it, which I knew would be the case from the contents of his letter to me of September 2, 1851—copy whereof, marked E, is annexed—and of his official communications, referred to therein, and which should be on file.

Whether the director has investigated any other of said charges and specifications against Mr. Peale, each of which I believe to be as well founded as that just mentioned, or has reported upon either, I do not know; but, when he shall have done so, and his report shall have become known to me, I may make such remarks, thereupon, as shall seem appropriate and necessary.

My presence at the mint, during part of the last winter, caused me, however, to know that the business of making medals in the mint is still carried on there by the coiner as actively as ever; and I was told that this is now done with the approbation of the Treasury Department, and by the advice of the present director; notwithstanding, that said business is not authorized by law, and is rendered practically a monopoly, by allowing the means of the Government to be used by an officer thereof, for his pecuniary gain, in unfair competition with private in-

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dustry, to the protection of which the avowed policy of the present Administration is professedly most favorable. And I do not doubt that, if the engraver of the mint had countenanced and assisted in the medal making business, he would neither have incurred the animosity of Mr. Peale, nor have been calumniated by him.

Very respectfully, your obedient servant,

RICHARD S. McCULLOH.

Hon. THOS. CORWIN,
Secretary of the Treasury.

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APPENDIX.

(A.)

MINT OF THE UNITED STATES,

Philadelphia, October 14, 1851.

SIR: A memorial of Professor Richard S. McCulloh to the President of the United States was enclosed to me in a letter from the Department, of the 11th of August last, with the request that I would make the necessary investigations and inquiries into the charges therein alleged against officers of the mint, and report the result to the Department; and, also, as to the expediency of causing Mr. McCulloh's method of refining gold to be again tried at the mint.

The charges alleged were against the chief coiner, Franklin Peale, for misconduct, which the memorial states, proves him "flagrantly unfit for the official position he now holds:"

Against the melter and refiner, James C. Booth, for "habitual absence from the mint, inconsistent with the public interest, and in derogation of law;" and also against the same officer, for unfairness in the experiments made in his department, with a view to test the practicability and expediency of Mr. McCulloh's method of refining gold; and the official proceedings of the late director, in regard to the same experiments, are also impeached.

Respecting the charges against Mr. Peale, I am, at present, not prepared to make a report.

Of the charges against the melter and refiner, for "habitual absence, inconsistent with the public interest, and in derogation of law," I may remark, that whether Mr. Booth be absent, a greater or less time than his predecessor, I cannot pretend to say. Since my connexion with the mint, he has faithfully discharged the duties of his office; nor have I any reason to suppose that he neglected them previously. The operations of his department are conducted with rapidity, energy, and ability, and exhibit a wastage very far within the legal limits of allowance.

In regard to the allegations of unfairness in conducting the experiments on Mr. McCulloh's process at the mint, it is apparent that, inasmuch as I did not myself witness these experiments, the grounds of any opinion I may have formed on this subject must be derived from the testimony of impartial persons, who were present at the trials; from a knowledge of facts, and from a candid and unprejudiced review of the voluminous correspondence which has taken place on the subject; embracing the letters of Mr. McCulloh and Mr. Booth, and those between the late director and the Department.

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Among the persons examined by me were—Messrs. Monell and Porter, workmen, who conducted two of the operations required by the process, and Mr. Stringfield, fellow-workman of the late John Thompson, who conducted the third operation.

The testimony of these men showed that the experiments were made with every care; that they were directed by Mr. Booth; and that he and the Director personally supervised the operation, and seemed anxious that the experiments should succeed.

The impression left on the minds of these witnesses was, that nothing requisite to the success of the experiments was left undone.*

There is a strong, almost irresistible, inference that this was the case, derived from the undeniable fact, that, at the time these experiments were tried under his supervision, the melter and refiner had a direct pecuniary interest in securing their successful issue. Having become legal owner of one-half of Mr. McCulloh's patent, had the results been such that the introduction of the process into the mint appeared desirable, Mr. Booth would have shared with Mr. McC. the sum appropriated by Congress for the purchase of the improvement—viz., $25,000. Considering this fact, it appears to me to be in contradiction of all our experience of human nature to suppose that Mr. Booth preferred to make so great a sacrifice of pecuniary interest, rather than give the process a fair trial.

A view has indeed been expressed by Mr. McC. that, as the one half of his patent was conveyed to Mr. Booth for the one half of a patent granted to the latter, which has proved "destitute of value," no consideration having been given, Mr. Booth ceased to have the interest alleged. I express no opinion as to the law of this view; and as to the want of value in Mr. Booth's invention, it is most emphatically denied by him; but supposing both the law and the fact to be as stated, it is quite certain that, while conducting these experiments, Mr. Booth *believed* himself to have a pecuniary interest in their success, and must be inferred to have acted accordingly.

An unfavorable inference as to the fair intentions of the late director has been drawn by Mr. McCulloh, from the circumstance that, although instructions had been issued from the Department to have Mr. McC.'s process tried in his presence, yet the director failed to do so; an explanation has already been presented on this subject, in the late director's letter to the Department of March 18th, in which he says—"I

*Note. In this the director is mistaken, as will appear by the letter to me of Mr. Porter of September 8th, 1851, copy of which, marked B, I have appended; and who therein says: "all the officers called *occasionally* to see how I got along. Dr. Patterson and his "son Robert paid particular attention to some of the trials as wether there is any gold "left in the furnace of which there is no doubt but to what amount I am unable to say "there is no other way of getting at the exact amount but tearing down the furnace. But "judging from appearance I dont think there is much remaining in the furnace." It is evident, therefore, that this workman knew that gold had been left in the furnace; though the late Director ascribed the apparent loss thereof to "volatilization." And of this gold, so left, I have myself since *caused seventeen ounces to be gathered in grains* from said furnace, besides more finely divided portions in the dirt, or sweep, which was not assayed, I believe, though I requested that it should be done. To consider such experiments as having been "made with every care" is preposterous. R. S. McCULLOH.

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present as my excuse, that supposing Mr. Booth to be entirely in Mr. McCulloh's confidence, and knowing him to be also legally and pecuniarily interested in a favorable result for the process, a personal presence of Mr. McCulloh seemed useless."

"The instructions from the Department had, I supposed, been issued in ignorance of that fact. I assure you that I intended no disrespect to the Department, or Mr. McCulloh, in the course taken. It was very far from my thoughts that the request for a trial in that gentlman's presence, had been suggested by his suspicions of being unfairly dealt with, by either Mr. Booth or myself."

I do not think it necessary to enlarge further upon the grounds of complaint, or defence, as to the course pursued in conducting the experiments, on the process of Mr. McC.; but shall conclude this branch of the subject, by expressing my conviction that the proceedings of the late director, and of the melter and refiner relative thereto, were influenced by a sincere desire to test its merits, and that every facility, towards ensuring its success, appears to have been afforded.

I am, nevertheless, of the opinion, and, as requested by the Department, so report, that it would be expedient to have a further trial of Mr. McCulloh's refining process at the mint. Among the reasons which influence me in this opinion, the most prominent are, the desire to ascertain, beyond controversy, whether gold, when melted with zinc, which his process requires, is necessarily exposed to the hazard of loss by volatilization; whether it can be expeditiously and properly *toughened*, and if the loss by volatilization, and the difficulty of toughening can be overcome, whether the process of Mr. McC. is as expeditious and economical as he believes and represents it to be. That such volatilization may take place in melting the metals at very high temperatures, is a fact which has been noticed by scientific authorities; but whether it is unavoidably incident to the melting of the mixed metals, even at the lowest possible temperature, is a problem which, both in a scientific and practical point of view, it seems to be important to solve. It may be possible that, in the experiments at the mint, on Mr. McC's process, by which a serious loss of gold was reported, the result arose from permitting the mixed zinc and gold to be melted at an excessive and unnecessary high temperature. I am informed, however, that every precaution was taken to keep down the heat to the lowest practicable point, and think it most probable that this was effected. But the agitation of any controversy, as to the past, may be easily prevented by submitting the process to a new experiment, to be made in the presence of Mr. McC., and I accordingly recommend that authority for that purpose be given by the Department.

Supposing such an experiment to be authorized, and to result, as may possibly be the case, in a loss of precious metal, I ask the instructions of the Department as to how the deficiency is to be supplied. Shall the loss be thrown upon the melter and refiner, and subsequently compensated to him by a credit for wastage; or shall he have the amount directly replaced to him, from our ordinary fund? By either of these courses the deficiency will be assumed by the Government.

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But it may, perhaps, be thought unjust that experiments, of which the benefit enures in part to a private citizen, should be tried exclusively at the public charge; and it may seem equitable, therefore, that the loss of gold, if over and above the ordinary wastage, should be borne by Mr. McCulloh.

I respectfully refer this matter to the consideration of the Department.

Very respectfully, your obedient servant,

GEO. N. ECKERT, *Director*.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

(B.)

PHILADELPHIA, *September 8th*, 1852.

Mr. McCULLOH,

DEAR SIR: You wanted to know the way that I pursued in tuffening the zinc gold on test as near as I can recollect it is as follows.

The first sample that I tried I could not get it melted owing to the construction of the furnace* I then made a bone ash test and tried it a second time to which I added lead and copper and could not succede in making it tuff I continued to run it from six o'clock in the morning till six the next morning I then stopped and tried another to which I added copper in order that it might come out about standard I run it all day till about nine o'clock in the evening I then commenced using borax and nitre and soon succeeded in making it tuff. All the officers called occasionally to see how I got along Dr. Patterson and his son Robert paid particular attention to some of the trials as whether there is any gold left in the furnace of which there is no doubt but to what amount I am unable to say there is no other way of getting at the exact amount but tearing down the furnace. But judging from appearance I dont think that there is much remaining in the furnace there was one sample of flux in particular ground soaked several days and then dried half of which was put down with fine silver in order to ascertain what amount of gold remained in the flux the other half was put down with borax nitre and soda both lots came out about the same.

Yours with respect,

ARCHIBALD PORTER.

(C.)

PRINCETON, *September 29th*, 1852.

SIR: As you have been requested to report to the Treasury Department, with reference to the expediency of causing my improved method of refining gold to be tested at the mint in my presence, I respectfully submit, for your information, copies of the memorial addressed by me to Congress on the 24th of Febuary last, and of my letter to the Secretary of the Treasury, dated Febuary 28th, 1851.

I would, however, invite your attention particularly to the consideration: that, notwithstanding an amount of the public money, exceed-

*The cupelling furnace built by Prof. Booth for this purpose.—R. S. McC.

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ing $5,000,000, has been kept during the past year, in the mint, to be advanced to depositors of bullion, for their accommodation, without discount or interest, and at an expense to the U. S. Treasury of six per cent. per annum, on said amount—or more than $300,000—yet said depositors have been subjected to vexatious delays of payment and loss of interest, by reason of the tardy and inefficient operations of the mint. And that this use of so large an amount of the public money, without producing the designed effect of preventing said delays of payment, and losses to depositors, might have been, and may still be, in great part avoided; and a reduction of the charges to said depositors, may likewise be effected, by the introduction of a more rapid and economical process for refining, than that employed. Certainly it has been, and is, a singular feature in the financial affairs of our country, that the gold industry or trade should receive the accommodation of millions of dollars, advanced from the Treasury, at an expense of six per cent. per annum, and without charge to the persons engaged in that trade; while either the iron, coal, lead, wheat, sugar, tobacco, rice, cotton, or any other industry, or any branch of trade or manufacturing, however important—not only does not receive similar aid, or gratuity, and would be met with scouting, if application therefor were to be made—but must also bear all the expenses of inspection, &c., though the assaying and coining of bullion is performed without charge.

It is manifest that the aforesaid accommodation, extended to the gold industry, by heavy, gratuitous and expensive advances from the U. S. Treasury, is not ascribable to any exclusive and peculiar claim it might be imagined to possess, upon the fostering care of the Treasury. And said accommodation seems to have been demanded chiefly, if not solely, by reason of the following circumstances: that the mint has been greatly embarrassed and the depositors of bullion incommoded by its inefficiency; that the Government has looked in vain to the mint, for any sound and wise views to guide or enlighten its policy, in relation to the coinage; or the settlement of international balances of trade, by transfers of the precious metals; and that arrangements, which had been devised by me to render the old, tardy, and expensive method of refining even practical upon a large scale, have been perpetuated and enlarged; while a more rapid, efficient and economical method was repelled; and even the trial of it, in such manner as was both proper and required by an order given by the Secretary of the Treasury, was persistingly avoided.

Such a course of official action I cannot reconcile with correct views of public duty, especially as in an extract from one of the letters of the late director to the Hon. J. R. Chandler, read in the House of Representatives, on the 30th of January, 1851, said director has stated that: "the difficulties at the mint have arisen altogether from a deficiency in our refining capacity."

In my letter of August 1st, 1851, to the President, which has been referred to you, I have set forth conclusions, which the proceedings of the melter and refiner, Mr. Booth, had compelled me reluctantly to adopt.

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Since I wrote that letter, I have obtained copies of several official papers which I had not previously seen, to wit: a report of Professor Booth to the director of the mint, dated February 6th, 1851, *recommending the adoption* of my process, and stating that volatilization of gold with zinc "can be entirely guarded against;" also the letters of the director of the mint to the Secretary of the Treasury, of February 24th, March 18th, and March 27th, 1851. But I find in these nothing to materially modify any views I had previously entertained, unless with reference to the motives of the director.

Certainly, the successive trials of my process, made in the mint, without my concurrence, present a most singular series of blundering operations and discordant results; and if they establish anything, it is that they were carelessly, unskilfully, and wrongfully performed.

For six months or more, it was contended erroneously that said process would produce only brittle gold; and when that objection was abandoned, as untenable; a theory of waste, by volatilization, was brought forward, concerning which we have:

1st. The report of the late director, of February 24th, that the experiment, tried to determine said waste, had exhibited "the annoying result of an actual gain of the precious metal by the process:"

2d. His report of March 18th, that an experiment of melting gold twice with zinc exhibited "an apparent loss of nearly 8 per cent.;" while two other experiments of melting gold with zinc, and subsequently refining the alloy, "appeared to confirm the fact of a loss of a little over $\frac{8}{10}$ths of one per cent."—results certainly not at all accordant:

3d. His report of March 27th, that a trial had been made by Mr. Booth, showing "a loss of 0.0028 per cent.," and throwing "some discredit on the previous experiments."

4th. His report of May 9th, that an experiment, designed to be conclusive, had shown the loss of refining with zinc to be "5.65 ounces per thousand, or more than nine times as great" as by the old or silver granulation process:

5th. That a repetition of this experiment was by the director declined, notwithstanding the melter and refiner suggested "that the zinc used in the experiment was not of the best quality," and wished further trial to be made.

Concerning these experiments I may say, that I attach no more weight to the objection of *waste by volatilization* founded upon them, than I did formerly to that of brittleness based upon trials made by Mr. Booth, conflicting with results previously obtained by myself, if not also by him, and which have since been confirmed according to the reports of his subsequent refinings at the mint.

That the experiments, with reference to loss by volatilization, were not accurate, is evident; and they should never have been performed in my absence, for they were so made, in avoidance of an order of the Secretary of the Treasury, requiring my process to be tried in my presence.

And although the director of the mint may have considered himself

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justified in neglecting said order, for the reason, as he states in his aforesaid letter of March 18th, that he supposed "Mr. Booth to be entirely in Mr. McCulloh's confidence," and knew "him to be also legally and pecuniarily interested in a favorable result for the process;" it was certainly well known to Mr. Booth, that he had no authority to represent or act for me; that I had ceased to have confidence in his proceedings; that I ascribed the aforesaid avoidance of orders to "feelings of animosity;" and that I insisted upon "the propriety of an authorized trial of *both* processes in my presence;" as will fully appear from my letter to said Booth of January 27th, 1851.—See No. 57 of the Appendix to the aforesaid memorial. And he also might and should have known, that, as his own process had been proved by his own trials to be inefficient, and therefore valueless, he could not equitably claim, nor justly retain, any interest in mine.

Of the disavowal of enmity towards myself, made by the late director, in his aforesaid letter to the Secretary of the Treasury of March 18th, 1851, I may appropriately remark, that he is of course the proper judge of his own feelings; but his course of official action, with reference to my method of refining, seemed to me and to my friends to be wrongful; for, if it had been planned at every step in personal hostility, it could scarcely have been rendered more injurious. If, therefore, I believed the statement, made to me by Prof. Booth, that such hostility was entertained towards me by Dr. Patterson, confirmed as that statement apparently was, by his own official course, that belief was not without sufficient foundation. And if, by electing to hold intercourse with me only through Mr. Booth, he may have suffered his feelings to be misrepresented, and caused his actions to be misinterpreted, it is to be regretted.

I have been, and may still be, obliged to challenge the fitness of some of his official proceedings, when I would have felt, as I hope always to find, pleasure in cherishing towards him feelings of the kindest regard.

In conclusion, I will add, that I have been informed that, in the last of the above mentioned experiments, tried with my process in the mint, the alloy was overheated, which alone must have vitiated the result; and that I am confident said process can readily be shown to be as free from waste, and far more efficient and convenient, than any other, especially by the use of apparatus which I have contrived for the purpose.

Very respectfully, your obedient servant,

R. S. McCULLOH.

Dr. G. N. Eckert,
Director of the mint.

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(D.)—*Abstract of accounts, United States Mint.*

Report of 1st Auditor, No. 105,120—4th quarter of the year, 1850.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	Silver alloy.	Copper alloy.	
Nov. 14....$2,255,202.35 Dec. 31.... 6,822,548.18	Nov. 14.....$16,045.47 Dec. 31..... 39,124.88	Nov. 14....$5,613.13 Dec. 31....13,498.26	Nov. 14....$2,844.37 Dec. 31....17,079.87	$447.72	Silver alloy 5 p. c. on and from Nov. 14.
Value....$9,077,750.53	Value $55,170.35	$19,111.39	$19,924.24	$447.72	Total.....$39,483.35

Report of 1st Auditor, No. 105,660.—1st quarter, 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	5 per cent. silver alloy.	Copper alloy.	Total.
588,234.062 oz. stand'd $10,943,889.51 value	51,067.05 oz., standard $59,423.46 value	$20,318.81	$25,679.97	$405.50	$46,404.28

Report of 1st Auditor, No. 106,256.—2d quarter, 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	2 per cent. silver alloy.	Copper alloy.	Total.
524,255.606 oz., stand'd $9,753,592.86 value	58,067.97 standard oz. $67,570 00 value	$23,255.71	$11,766.71	$734.65	$35,757.07

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ABSTRACT—Continued.

Report of 1st *Auditor*, *No.* 106,694.—*3d quarter*, 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	2 per cent. silver alloy.	Copper alloy.	Total.
605,895.772 stand. oz. $11,272,479.49 value	68,007.08 standard oz. $79,135.51 value	$27,304.17	$13,819.28	$861.70	$41,985.15

Report of 1st *Auditor*, *No.* 107, 165.—*4th quarter*, 1851.

GOLD DEPOSITED.	SILVER PARTED.	DEDUCTIONS.			
		For parting.	2 per cent. silver alloy.	Copper alloy.	Total.
850,590.247 stand. oz. $15,824,934.82 value	97,399.74 stand'd oz. $113,337.88 value.	$39,530.68	$20,031.92	$1,244.87	$60,807.47

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(E.)

PHILADELPHIA, *September 2d*, 1851.

DEAR SIR: You request me to inform you of what transpired in my interviews with the Secretary of the Treasury, and with the director of the mint, in addition to furnishing you with copies of my letters to those officers, in relation to difficulties connected with the preparation of the "*dies* for the coinage of double eagles."

From the character of the letters referred to, they are, or ought to be, matters of record on the files of the offices respectively, to whose incumbents for the time being, they were addressed. But to obviate the difficulty of referring, I have no hesitation in supplying you from the original drafts of those letters in my hands.

With regard to interviews with those officers, on the same subject, I can undertake to do no more than give the stronger points which impressed me, on those occasions.

With the Secretary of the Treasury, I became satisfied, that my position as an officer of the Government, as well as the discharge of my duties, had been most unfairly represented, and that by communications emanating from the mint, without my knowledge. One fact will suffice to show the grounds of my conclusion. On exhibiting an impression from the dies I had just finished, he inquired with evident surprise, "what had become of the *dies* from which it was taken," implying that he had been informed they were broken, when at the time I knew them to be in perfect order; as I then told him.

Without the interview which I was compelled to seek with the Secretary of the Treasury, and the consequent explanation of difficulties that had occurred, I have reason to believe, that the misrepresentation of *this* and other matters, pertaining to my official position, would have been seriously prejudicial to my character, not only as an officer of the Government, but as an artist.

With the director, I regret to say, that my interviews were less satisfactory. In the first place, I found it difficult to obtain an interview without the intrusion of another officer, which rendered a confidential communication impossible; and which was in fact the primary cause of my addressing him the letter to which reference has been made, and in which I was compelled to call his attention to the conduct towards me of the chief coiner, in my official intercourse with that officer. To that letter a written reply was not given; the director noticed verbally some of the points on a visit to my office-room; but the complaint of official obstructions, in my intercourse with the chief coiner, was not adverted to. A few days after, however, I received another visit from the director, when he informed me that he had painful intelligence to communicate to me; which was, that I was to be removed from office; that the communication from the executive authority of the Government was imperative, and urgently advised me to send in my resignation.

It was the unexpected character of this interview, which impelled me to seek one with the Secretary of the Treasury, from a conviction

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that a purpose so unfriendly, on the part of that officer, could only have been formed, in the absence of correct information, as to my position, and the proper discharge of my official duties; and which information it then became a duty to myself to convey, in such a manner as would admit of no prejudicial intervention.

The result was such as to justify, to the fullest extent, the apprehension I had entertained.

Respectively, yours, &c.,

JAMES B. LONGACRE.

R. S. McCULLOH, esq.

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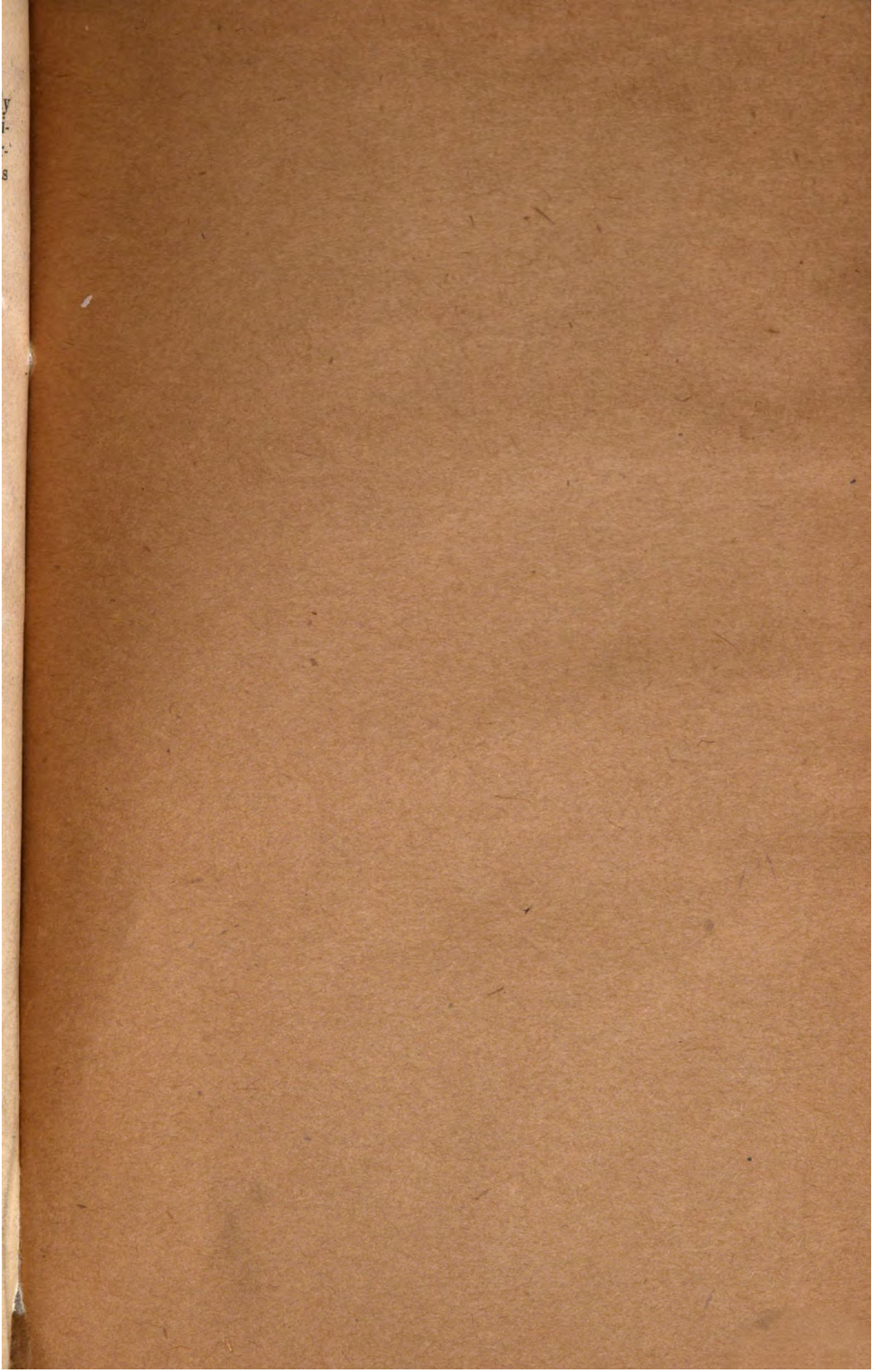

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McCulloh

Report ... of his operations at the mint of the United States in refining California gold by his zinc method

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